

Pregnancy Nutrition Surveillance



2008 Report

National Center for Chronic Disease Prevention and Health Promotion
Division of Nutrition, Physical Activity and Obesity



This report summarizes selected data on maternal health and nutrition indicators received from states, U.S. territories, and Indian Tribal Organizations that contributed to the Centers for Disease Control and Prevention's (CDC) Pregnancy Nutrition Surveillance System.

This report was developed by CDC's Division of Nutrition, Physical Activity and Obesity in the National Center for Chronic Disease Prevention and Health Promotion.

Suggested Citation

Reinold C, Dalenius K, Brindley P, Smith B, Grummer-Strawn L. *Pregnancy Nutrition Surveillance 2008 Report*. Atlanta: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention; 2010.

Acknowledgements

We gratefully acknowledge and thank all contributors to the national Pregnancy Nutrition Surveillance System. The efforts of state, territorial, and Indian Tribal Organization surveillance coordinators; informatics staff; and local clinic staff to collect data and use nutrition surveillance systems make the Pregnancy Nutrition Surveillance System possible.

This report is available online at
http://www.cdc.gov/pednss/pdfs/PNSS_2008.pdf

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Pregnancy Nutrition Surveillance

The Pregnancy Nutrition Surveillance System (PNSS) is a public health surveillance system that monitors the prevalence of nutrition problems, behavioral risk factors, and birth outcomes among low-income women who are enrolled in public health programs in states or U.S. territories or through Indian Tribal Organizations (ITOs).

The goal of the PNSS is to collect, analyze, and disseminate surveillance data to guide public health policy and action. The collected data are used to set public health priorities and to plan, implement, and evaluate nutrition programs for pregnant women. This report summarizes PNSS data from 2008 and highlights data trends from 1999 through 2008.

The PNSS collects demographic data about maternal age, race and ethnicity, education level, household income, migrant status, and participation in food and medical assistance programs. Information about a mother's height; weight before, during, and after pregnancy; hemoglobin and hematocrit levels; parity; medical care during pregnancy; and enrollment in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) is collected.

Information also is collected about patterns of maternal smoking and alcohol consumption 3 months before and during pregnancy. Data collected about infants include date of birth, birthweight, and breastfeeding status.

Data are collected at the clinic level, aggregated at the state level, and then submitted to the Centers for Disease Control and Prevention (CDC) for analysis. The PNSS generates surveillance reports for each contributor and for the nation (all participating contributors).

A *contributor* is defined as a state, U.S. territory, or ITO.

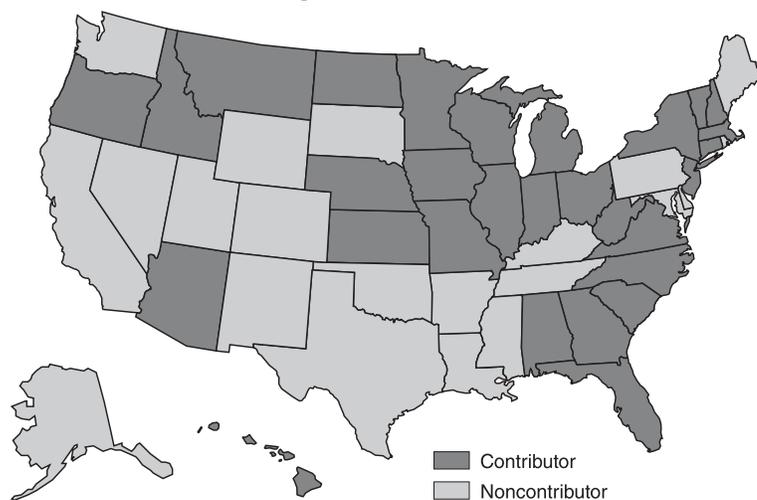
In 2008, the PNSS included 30 states, the District of Columbia, 6 ITOs, and 1 U.S. territory (Figure 1). These contributors provided more than 1.3 million records to the system, nearly double the number of records in 1999. This increase is largely due to the expanded number of contributors to the PNSS. Fluctuations in the number of contributors and records can affect trends. The number of PNSS contributors differs slightly from year to year because some contributors did not provide data every year during the 10-year period from 1999 through 2008 (Table 1). The WIC program has consistently been the primary source of PNSS data, contributing nearly 100% of the records in 2008.

Demographic Characteristics

Income

More than 60% of women who participated in the 2008 PNSS and were eligible for WIC had gross incomes equal to or less than 100% of the U.S. poverty level. To be eligible for the WIC program, an applicant's gross income must be equal to or less than 185% of the 2008 U.S. Department of Health and Human Services' poverty guidelines.

Figure 1. Contributors* to the 2008 Pregnancy Nutrition Surveillance System



* Includes the District of Columbia, Puerto Rico, and the following Indian Tribal Organizations: the Cheyenne River Sioux Tribe (SD), the Inter Tribal Council of Arizona, the Northern Arapaho Tribe (WY), the Rosebud Sioux Tribe (SD), the Standing Rock Sioux Tribe (ND), and the Three Affiliated Tribes (ND).

Table 1. Contributors to the Pregnancy Nutrition Surveillance System, 1999–2008*

Contributor	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Alabama										
Arizona										
Inter Tribal Council (AZ)										
America Samoa										
Cheyenne River Sioux (SD)										
Chickasaw Nation (OK)										
Connecticut										
District of Columbia										
Florida										
Georgia										
Hawaii										
Idaho										
Illinois										
Indiana										
Iowa										
Kansas										
Massachusetts										
Michigan										
Minnesota										
Missouri										
Montana										
Nebraska										
New Hampshire										
New Jersey										
New York										
Northern Arapaho (WY)										
North Carolina										
North Dakota										
Ohio										
Oregon										
Puerto Rico										
Rhode Island										
Rosebud Sioux (SD)										
South Carolina										
Standing Rock Sioux (ND)										
Three Affiliated Tribes (ND)										
Utah										
Vermont										
Virginia										
West Virginia										
Wichita Caddo (OK)										
Wisconsin										
Number of Contributors	26	26	29	27	29	31	31	32	34	37
Total Records Submitted (x1,000)	694	751	739	727	769	856	857	1,143	1,253	1,308

* Shaded blocks indicate years that data were contributed.

Race and Ethnicity

Of the women in the 2008 PNSS, 42.0% were non-Hispanic white, 24.2% were non-Hispanic black, 28.1% were Hispanic or Latina, 3.1% were Asian or Other Pacific Islander, 1.0% were American Indian or Alaska Native, and 1.1% were of multiple races. In the 2008 PNSS, a smaller proportion of women was non-Hispanic white (42.0%) compared with the proportion of women in the 1999 PNSS (54.5%), and a higher proportion of the sample was Hispanic or Latina in 2008 (28.1%) than in 1999 (15.6%).

Age

In the 2008 PNSS, 59.9% of women were aged 20–29 years, 19.4% were aged 30–39 years, and 1.4% were aged 40 years or older. The proportion of teenaged mothers declined from 24.9% in 1999 to 19.2% in 2008. The proportion of pregnant women aged 30 years or older increased from 16.8% in 1999 to 20.8% in 2008.

Education

In the 2008 PNSS, 32.1% of women had less than a high school education, and this proportion has changed little during the past decade. Among all women in the United States, 26.4% of those who gave birth in 2006 had less than a high school education.¹

Maternal Health Indicators

Prepregnancy Weight Status

Prepregnancy weight is a determinant of infant birthweight. For example, studies suggest an association between being underweight before pregnancy and giving birth to an infant with low birthweight.² Obese women are at increased risk for preeclampsia, gestational diabetes, cesarean delivery, and failure to initiate breastfeeding.^{2,3}

Prepregnancy body mass index (BMI) was calculated for each woman in the 2008 PNSS and was based on self-reported weight and height. Women were classified by the 1990 Institute of Medicine's (IOM) BMI categories.⁴ *Underweight* is defined as less than 19.8 BMI. *Normal weight* is defined as 19.8–26.0

BMI. *Overweight* is defined as 26.1–29.0 BMI, and *obese* is defined as greater than 29.0 BMI.

In 2009, the IOM released updated guidelines for categorization of BMI values for women and weight gain during pregnancy that take into account changes in the U.S. population, particularly the increasing percentage of women who are overweight or obese.⁵ The release of these guidelines occurred simultaneously with publication of the statistics for this report, so adoption of the new standards is deferred to the 2009 PNSS report.

In the 2008 PNSS, 10.7% of women were underweight, 43.9% were normal weight, 15.2% were overweight, and 30.2% were obese. The overall proportion of women in the 2008 PNSS who were overweight or obese was 45.4%; proportions varied by contributor, from 37.8% (Puerto Rico) to 63.4% (Inter Tribal Council of Arizona) (Table 2).

From 1999 through 2008, the prevalence of women who were overweight or obese before pregnancy increased from 39.9% to 45.4%, but the percentage of women who were underweight before they became pregnant decreased from 14.1% to 10.7% (Figure 2).

Maternal Weight Gain

The 1990 IOM report recommends a pregnancy weight gain of 28–40 pounds for underweight women, 25–35 pounds for women of normal weight, 15–25 pounds for overweight women, and at least 15 pounds for obese women.⁴ For this report, we use a range of 15–25 pounds for both overweight and obese women. As noted in the previous section, adoption of the 2009 IOM guidelines on weight gain during pregnancy⁵ is deferred to the 2009 PNSS report.

Women who gain less than the IOM's recommended weight gain during pregnancy are at increased risk of giving birth to an infant with low birthweight. Women who gain more than the IOM's recommended weight gain during pregnancy are at increased risk of giving birth to an infant with high birthweight, which can cause difficulty with delivery.⁴

Table 2. State-specific Prevalence of Selected Indicators of Maternal Health, 2008 Pregnancy Nutrition Surveillance System*

Contributors	Smoking																	
	Under-weight [†]	Over-weight [†]	< Ideal wt gain [‡]	> Ideal wt gain [‡]	3rd trim anemia [§]	Post p anemia	1st trim med	No med	1st trim WIC	3 mos b/f preg	3rd trim	House prenatal	House post p	LBW [¶]	HBW ^{**}	Pre-term ^{††}	Ever BF ^{‡‡}	
Alabama	12.0	49.8	*	*	41.0	39.0	*	*	38.5	*	*	*	*	10.3	4.5	14.9	*	
Arizona	10.7	43.6	22.8	46.6	26.0	22.6	*	*	33.9	7.0	3.4	5.6	6.1	7.0	6.8	11.6	65.5	
Inter Tribal Council (AZ)	4.3	63.4	24.0	48.6	30.8	31.0	71.5	3.5	34.0	12.3	2.1	14.0	12.7	7.2	8.0	11.7	66.8	
Cheyenne River Sioux (SD)	9.0	52.1	28.7	39.1	*	48.5	*	*	41.3	55.8	*	31.1	20.6	8.1	8.9	13.0	42.9	
Connecticut	9.5	45.0	*	*	29.4	53.2	85.3	3.6	23.5	25.1	3.1	13.8	6.4	7.2	7.7	7.7	66.5	
District of Columbia	8.1	47.8	29.4	36.3	47.9	40.0	*	*	22.7	7.6	4.4	13.2	9.6	9.9	5.5	16.3	50.6	
Florida	11.2	43.2	25.9	43.7	39.9	37.4	*	*	30.1	15.5	21.0	*	*	8.6	6.0	13.4	72.0	
Georgia	9.7	48.0	26.3	43.6	41.6	29.3	81.9	3.0	29.0	*	*	*	*	9.6	5.1	13.5	47.9	
Hawaii	12.9	39.1	21.6	47.8	29.0	22.6	74.6	5.8	21.9	*	*	*	*	7.4	6.9	4.8	85.4	
Idaho	9.4	44.9	20.2	44.7	22.4	19.4	*	*	30.2	23.5	12.2	22.2	19.9	6.4	7.0	10.4	82.8	
Illinois	9.8	46.8	27.8	41.8	32.4	34.9	*	*	35.3	19.5	11.2	17.9	16.0	6.3	7.3	8.5	65.8	
Indiana	11.5	46.9	20.8	48.8	36.9	27.4	*	*	23.7	28.6	21.3	34.8	30.7	8.6	6.5	15.1	63.2	
Iowa	7.9	50.6	19.4	46.7	28.0	21.9	*	*	43.4	40.8	25.1	24.4	15.4	7.9	8.0	11.1	*	
Kansas	10.9	46.6	22.9	45.6	29.3	24.0	74.9	5.2	39.8	32.9	18.5	17.6	16.1	7.2	6.5	10.7	69.4	
Massachusetts	11.0	41.2	23.2	45.9	34.2	29.5	73.3	10.6	34.1	22.7	11.3	17.6	13.6	7.7	7.9	9.4	73.4	
Michigan	10.3	47.1	30.9	41.8	33.4	32.4	79.4	5.8	32.0	36.3	22.8	13.6	6.2	8.2	7.5	4.7	54.7	
Minnesota	9.1	46.4	31.5	36.4	29.2	19.3	*	*	33.9	28.9	11.6	*	*	6.6	8.9	9.7	74.8	
Missouri	11.4	46.4	19.7	45.8	38.2	31.0	*	*	43.0	37.3	23.7	36.5	25.0	8.1	6.3	10.3	55.4	
Montana	9.8	44.8	24.1	45.5	15.4	22.3	79.2	9.0	25.4	38.4	6.7	20.6	17.7	6.6	8.1	12.0	77.1	
Nebraska	9.5	47.3	24.6	41.2	28.1	26.5	87.0	2.7	26.5	34.4	17.4	*	*	7.5	6.8	10.5	70.3	
New Hampshire	11.7	42.1	19.8	50.6	27.7	21.3	90.3	1.5	38.8	42.8	27.2	36.9	34.8	6.2	9.9	7.5	74.3	
New Jersey	9.2	43.8	24.3	38.9	35.7	50.0	*	*	25.4	6.9	4.1	9.3	9.1	7.6	6.3	14.7	61.5	
New York	10.7	42.7	25.7	35.9	37.1	31.9	84.7	1.8	28.1	17.1	8.5	7.5	*	8.0	6.8	11.1	71.4	
North Carolina	11.1	47.8	26.6	39.9	35.0	31.6	76.0	0.7	25.6	24.7	14.9	*	*	9.3	6.4	14.0	61.0	
North Dakota	7.9	49.2	18.2	48.0	26.7	20.4	*	*	44.2	48.1	24.4	21.7	12.1	8.7	9.5	12.3	*	
Northern Arapaho (WY)	5.3	56.5	*	*	*	*	*	*	33.3	*	*	*	14.3	9.5	9.5	11.4	66.7	
Ohio	11.3	47.0	25.5	45.6	30.9	25.4	82.3	1.6	31.6	44.1	22.1	38.9	34.9	8.9	6.0	11.7	*	
Oregon	8.6	47.6	19.5	44.7	27.4	19.3	50.6	1.6	36.3	*	*	*	*	5.7	9.7	8.5	91.2	
Puerto Rico	15.4	37.8	29.0	35.2	37.8	31.2	90.7	0.3	*	3.6	3.7	10.6	10.4	10.1	2.7	18.0	55.3	
Rhode Island	10.0	42.4	24.2	42.7	32.9	34.2	85.5	4.4	43.4	18.5	10.9	19.1	14.9	8.1	7.8	15.2	59.0	
Rosebud Sioux (SD)	6.6	51.7	38.1	32.9	*	47.0	*	*	29.9	41.1	14.1	35.8	23.1	7.2	8.1	11.8	74.4	
South Carolina	11.4	47.8	20.7	45.7	33.7	31.7	*	*	31.3	26.6	14.5	21.5	19.6	9.6	5.3	*	*	
Standing Rock Sioux (ND)	6.0	56.0	39.0	39.8	*	40.2	*	*	36.4	51.2	*	*	*	9.4	12.8	14.3	54.3	
Three Affiliated Tribes (ND)	4.5	53.6	*	*	*	*	*	*	35.1	61.5	*	*	*	*	*	*	*	*
Vermont	11.5	46.0	21.6	44.3	23.0	21.1	77.9	0.5	35.2	47.8	29.7	*	*	7.3	10.6	9.9	74.4	
Virginia	10.7	46.5	21.9	42.8	35.0	26.5	73.8	2.4	30.6	29.8	11.9	22.7	46.4	9.4	6.5	10.6	60.0	
West Virginia	14.8	44.8	19.6	45.8	32.0	23.1	84.0	5.2	48.7	51.2	33.8	26.7	18.1	10.0	6.3	13.2	42.5	
Wisconsin	9.5	47.2	24.2	45.8	32.5	24.8	84.0	2.3	33.0	36.6	20.4	21.6	7.9	7.7	7.8	10.2	67.0	
National PNSS	10.7	45.4	25.0	42.5	33.8	29.6	80.1	3.1	31.7	23.1	14.2	18.9	19.9	8.2	6.6	11.5	65.4	

Abbreviations: Wt = weight; Trim = trimester; Post p = postpartum; Med = entry to medical care; WIC = Special Supplemental Nutrition Program for Women, Infants, and Children; Mos = months; B/f = before; House = household; LBW = low birthweight; HBW = high birthweight; Ever BF = ever breastfed.

* Percentages are not calculated if <100 records were available for analysis after exclusions.

† Prepregnancy weight status: Underweight = body mass index (BMI) <19.8; Overweight = BMI ≥26.1 (includes overweight and obese). Source: Institute of Medicine. *Nutrition During Pregnancy*. Washington, DC: National Academy Press; 1990.

‡ Recommended pregnancy weight gain = 28–40 lbs if underweight, 25–35 lbs if normal weight, and 15–25 lbs if overweight or obese. Source: Institute of Medicine. *Nutrition During Pregnancy*. Washington, DC: National Academy Press; 1990.

§ Adjusted for altitude and smoking. Source: CDC. Recommendations to prevent and control iron deficiency in the United States. *MMWR* 1998;47(RR-3):1–29.

¶ Defined as birthweight <2,500 grams.

** Defined as birthweight >4,000 grams.

†† Defined as gestational period <37 weeks.

‡‡ Among infants born during the reporting period. *Healthy People 2010* target: Increase the proportion of mothers who breastfeed their babies during the early postpartum period to 75%.

Additionally, women who gain excess weight during pregnancy may have more difficulty returning to their prepregnancy weight.⁵ In the 2008 PNSS, 25.0% of women gained less weight than recommended during pregnancy, 32.5% gained the recommended amount of weight, and 42.5% gained more weight than recommended. The proportion of women in the 2008 PNSS who gained more than the recommended amount of weight during pregnancy varied by contributor, from 32.9% (Rosebud Sioux Tribe in South Dakota) to 50.6% (New Hampshire) (Table 2).

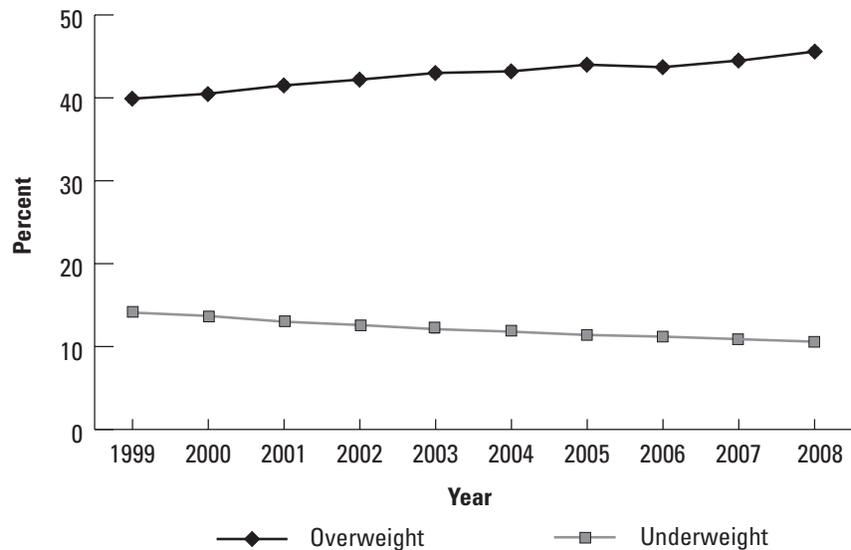
Whether the women in the 2008 PNSS gained an adequate amount of weight during pregnancy varied significantly by the women's prepregnancy BMI (Figure 3). Women who were overweight or obese before pregnancy were more likely to exceed the IOM's recommended maximum weight gain for their body size. Excess weight gain during pregnancy and failure to lose weight after pregnancy are important and identifiable predictors of long-term obesity.⁶

From 1999 through 2008, the prevalence of women who gained too much weight during pregnancy rose slightly, from 41.3% to 42.5%, and the prevalence of women who gained less than the IOM's recommended weight gain during pregnancy dropped from 28.4% to 25.0%.

Anemia

Iron deficiency is common among women of reproductive age and during pregnancy.⁷ Because pregnant women require higher amounts of iron, iron supplementation during pregnancy is often

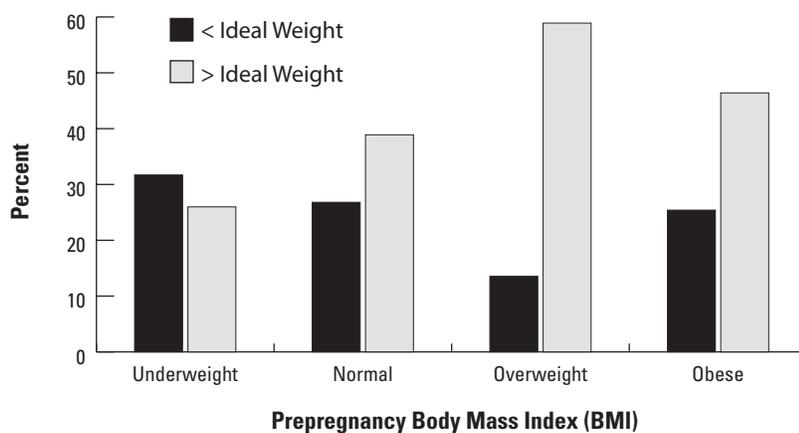
Figure 2. Trends in prevalence* of prepregnancy overweight and underweight†



* All trend data in this report are based on participants that vary slightly from year to year. Comparisons should be made with caution.

† Overweight = body mass index (BMI) ≥ 26.1 (includes overweight and obese); Underweight = BMI < 19.8 .

Figure 3. Maternal weight gain* by prepregnancy body mass index†



* A 1990 report by the Institute of Medicine recommends a prepregnancy weight gain of 28–40 lbs if underweight, 25–35 lbs if normal weight, and 15–25 lbs if overweight or obese before pregnancy.

† Underweight = BMI < 19.8 ; normal = BMI 19.8–26.0; overweight = BMI 26.1–29.0; obese = BMI > 29.0 .

recommended. Pregnant women may not receive an adequate amount of iron if they do not take iron supplements during pregnancy, or if they fail to take iron supplements during the first trimester of pregnancy.⁷

Iron-deficiency anemia during the first two trimesters of pregnancy has been associated with inadequate gestational weight gain, a two-fold risk for preterm delivery, and a three-fold risk of giving birth to an infant with low birthweight.⁸ Iron-deficiency anemia during the third trimester of pregnancy is associated with a two-fold risk of an inadequate weight gain for gestation.⁸

In the 2008 PNSS, 7.6% of women had anemia* when they enrolled in the WIC program during their first trimester, 12.1% had anemia when they enrolled in the program during their second trimester, and 33.8% had anemia when they enrolled during their third trimester. Women who enrolled in the WIC program during their third trimester were more likely to start prenatal care late in pregnancy and may not be representative of all low-income women in their third trimester of pregnancy. *Healthy People 2010* Objective 19-13 proposes reducing the prevalence of third trimester anemia among low-income pregnant females to no more than 20%.⁹

In the 2008 PNSS, the prevalence of anemia in the third trimester of pregnancy was highest for black mothers (48.5%). The prevalences for other racial and ethnic groups were all above the *Healthy People 2010* target of 20% (27.5% for whites, 30.1% for Hispanics or Latinas, 33.9% for American Indians or Alaska Natives, and 29.0% for Asians and Native Hawaiians or Other Pacific Islanders).

From 1999 through 2008, the overall prevalence of anemia during the third trimester of pregnancy rose slightly, from 29.9% to 33.8%. In the 2008 PNSS, only Montana met the *Healthy People 2010* objective for the prevalence of anemia during the third trimester of pregnancy.

Women at risk for anemia at 4–6 weeks postpartum should be screened.⁷ In the 2008 PNSS, 29.6% of postpartum women were anemic at 6 or more weeks after delivery. Race/ethnic disparities were similar to those described previously for pregnant women, with anemia rates ranging from 27.5% among white mothers to 48.5% among black mothers.

Interpregnancy Interval

Interpregnancy interval is the time between the end of one pregnancy and the last menstrual period before the next pregnancy. Women with an interpregnancy interval of less than 6 months are at higher risk for maternal mortality and morbidity, giving birth to infants with low birthweight or infants who are small for gestational age, and giving birth preterm than women conceiving after an interpregnancy interval of 18–23 months.^{10,11} In addition, a shorter interpregnancy interval means less time for repletion of nutrient stores.¹² In the 2008 PNSS, 12.6% of all women had an interpregnancy interval of less than 6 months, and 27.1% had an interval of 6 months to less than 18 months.

Maternal Behavioral Indicators

Prenatal Care

The quality, quantity, and timing of prenatal care influence pregnancy outcome, and inadequate prenatal care increases a woman's risk for poor pregnancy outcome.¹³ *Healthy People 2010* Objective 16-6a proposes increasing the proportion of pregnant women who receive prenatal care during the first trimester to 90%. According to national health statistics in 2006, 68.3% of women sought prenatal care during their first trimester, and 8.2% of women received no prenatal care during pregnancy.¹⁴

In the 2008 PNSS, 80.1% of women began prenatal care during their first trimester, an increase from 74.2% reported in 1999, and 3.1% received no prenatal care. Mothers aged 19 years or younger were less likely than older mothers to obtain prenatal care during the first trimester. By age group, 58.9% of

* Anemia: Low hemoglobin (Hb) or low hematocrit (Hct). CDC defines anemia during pregnancy as follows: first trimester, Hb <11.0 g/dl or Hct <33%; second trimester, Hb <10.5 g/dl or Hct <32%; and third trimester, Hb <11.0 g/dl or Hct <33%.⁷

teenagers younger than 15 years, 71.4% of those aged 15–17 years, and 77.8% of those aged 18–19 years obtained prenatal care during the first trimester.

White women (82.8%) were more likely to obtain prenatal care during the first trimester of pregnancy than blacks (78.2%), Hispanics (77.8%), American Indians or Alaska Natives (75.6%), or Asians and Native Hawaiians or Other Pacific Islanders (78.1%).

WIC Enrollment

Several studies have concluded that participation in the WIC program is associated with improved birthweights and fewer preterm deliveries.^{13,15} Another study concluded that participation in the WIC program during pregnancy resulted in fewer deliveries of infants who are small for gestational age, and healthier infants were linked to longer enrollment in the program.¹⁶

In the 2008 PNSS, 31.7% of women enrolled in the WIC program during their first trimester, 34.0% during their second trimester, 18.4% during their third trimester, and 16.0% after giving birth. The proportion of women who enrolled during their first trimester increased from 27.7% in 1999. Percentages varied among contributors, from 21.9% (Hawaii) to 48.7% (West Virginia) (Table 2).

Maternal Smoking

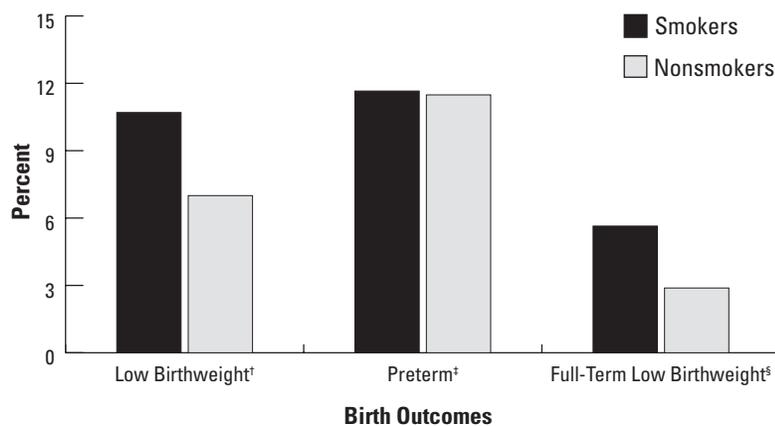
Infants born to mothers who smoke cigarettes during pregnancy have a 40.0% higher rate of mortality than infants born to nonsmoking mothers.¹⁷ Small gestational size, rather than preterm birth, is the main mechanism through which smoking causes excess infant mortality.¹⁷ The percentage of preterm births is not significantly different for smoking mothers when compared with nonsmoking mothers, but the percentages of low birthweight and full-term low birthweight are significantly higher for infants born to smoking mothers (Figure 4).

Maternal smoking also increases the risk for sudden infant death syndrome (SIDS)¹⁸ and spontaneous abortion,¹⁹ and it has long-term negative effects on the growth, development, behavior, and cognition of the infant.^{20,21} *Healthy People 2010* Objective 16-17c proposes increasing the rate of abstinence from smoking during the last month of pregnancy to 98%.

In the 2008 PNSS, 23.1% of women reported smoking during the 3 months before they became pregnant, and 14.2% reported smoking during the last 3 months of their pregnancy. The proportions of women who smoke before pregnancy or during the last trimester of pregnancy have consistently declined since 1999, when 34.8% of women reported that they smoked before becoming pregnant, and 22.9% reported smoking during their last trimester.

In the 2008 PNSS, the prevalence of smoking during the last 3 months of pregnancy was highest among white women (25.0%), women aged 20–29 years (15.4%), and women with less than a high school education (16.8%). The proportion of women in the 2008 PNSS who smoked during their last trimester of pregnancy varied widely by contributor, from 2.1% (Inter Tribal Council of Arizona) to 33.8% (West Virginia) (Table 2).

Figure 4. Birth outcomes by smoking status*



* A smoker is defined as a woman who uses any tobacco in the last 3 months of pregnancy.

¹ Defined as birthweight <2,500 grams.

² Defined as gestational period <37 weeks.

³ Defined as born at or after 37 weeks gestation with birthweight <2,500 grams.

The PNSS also monitors the proportion of women who quit smoking. Of the 23.1% of women who reported smoking during the 3 months before they became pregnant, 42.1% reported that they quit smoking by the time they enrolled in WIC, and 35.5% of these women abstained from smoking during the last 3 months of their pregnancies.

Household Smoking

Studies of the association between passive smoking during pregnancy and birth outcomes provide mixed findings on the effect of passive smoking on infant birthweight. However, the effects of household smoking on infants' health are better documented.^{22,23} Exposure to passive smoke during the first 2 years of a child's life is associated with a higher incidence of SIDS, respiratory infection, and chest illness.²³

In the 2008 PNSS, 18.9% of women reported that during their pregnancy, someone other than themselves smoked in their household, and 19.9% reported that someone else in the household smoked during the weeks following the birth of the infant.

Birth Outcomes

Low Birthweight

Low birthweight (<2,500 grams) is associated with neonatal and postneonatal mortality.²⁴ Infants with low birthweight who survive are at increased risk for health problems that range from neurodevelopmental handicaps to conditions of the lower respiratory tract.²⁵

Healthy People 2010 Objective 16-10a proposes reducing the incidence of low birthweight to 5%.¹⁰ In the 2008 PNSS, 8.2% of infants had low birthweights; this proportion is the same as the proportion of U.S. infants born with low birthweights in 2007.²⁶ The incidence of low birthweight varies by contributor, from 5.7% (Oregon) to 10.3% (Alabama) (Table 2).

The overall incidence of low birthweight in 2008 (8.2%) was slightly higher than the incidence in 1999 (7.9%). By racial and ethnic group, the

incidence was higher for black infants (11.8%) than for white (7.3%), Hispanic (6.8%), Asian and Native Hawaiian or Other Pacific Islander (7.6%), or American Indian or Alaska Native (7.4%) infants.

High Birthweight

A high birthweight (>4,000 grams) is associated with an increased risk for birth injuries such as shoulder dystocia.²⁷ In the 2008 PNSS, 6.6% of infants had high birthweights, compared with 8.4% in 1999. The prevalence for high birthweight varied by contributor, from 2.7% (Puerto Rico) to 12.8 (Standing Rock Sioux Tribe in North Dakota) (Table 2). American Indians or Alaska Natives had the highest rate (9.3%), followed by whites (7.9%), Hispanics (6.8%), Asians and Native Hawaiians or Other Pacific Islanders (4.7%), and blacks (4.1%).

Preterm Births

Preterm birth refers to infants who are born before 37 weeks gestation. It is associated with increased risk for newborn health complications; long-term disabilities such as mental retardation, cerebral palsy, lung and gastrointestinal problems, vision and hearing loss; and death.²⁸ Factors related to preterm birth include iron-deficiency anemia during pregnancy, low gestational weight gain, low income, race and ethnicity, young age of the mother, smoking, and low educational attainment.¹²

Healthy People 2010 Objective 16-11a proposes reducing preterm births to 7.6%. In the 2008 PNSS, 11.5% of infants were born prematurely, slightly up from 11.0% in 1999. The prevalence of preterm births differed by race, with black infants having a higher prevalence (13.7%) than American Indians or Alaska Natives (12.6%), Hispanics (11.9%), whites (10.1%), or Asians and Native Hawaiians or Other Pacific Islanders (9.2%).

Full-Term Low Birthweight

The PNSS monitors the proportion of full-term, low-birthweight infants and uses this proportion as an indicator to diagnose intrauterine growth retardation or fetal growth restriction.¹² An infant is considered full term with low birthweight if the infant is born at or after 37 weeks gestation but

weighs less than 2,500 grams. Poor nutrition during pregnancy is cited as one of the causes of full-term, low-birthweight infants.¹² An infant's size at birth is important because fetal growth retardation contributes to the risk for respiratory distress, hypoglycemia, and other health problems in infants.¹²

In the 2008 PNSS, 3.6% of infants who were born full term had low birthweight, which is slightly lower than the 3.8% reported in 1999. Black infants (5.3%) had a higher prevalence of being full term with low birthweight than infants from other racial or ethnic groups.

Infant Feeding Practices

Breastmilk, which is nutritionally superior to any other milk supply, provides infants with many benefits, including a reduction in acute otitis media, nonspecific gastroenteritis, severe lower respiratory tract infection, asthma, obesity, type 1 and 2 diabetes, childhood leukemia, SIDS, and necrotizing enterocolitis.²⁹

The proportion of breastfed infants in the PNSS has steadily increased in recent years. In 2008, 65.4% of infants were breastfed, compared with 49.9% in 1999. *Healthy People 2010* Objective 16-19 proposes increasing the proportion of infants ever breastfed to 75%.¹⁰ Only four states in the 2008 PNSS met this objective: Hawaii, Idaho, Montana, and Oregon. The percentage of infants ever breastfed varied widely among contributors, from 42.5% (West Virginia) to 91.2% (Oregon) (Table 2).

Breastfeeding initiation varied by race/ethnicity. In the 2008 PNSS, initiation rates ranged from 55.1% among black mothers and 63.0% among white mothers to 75.8% among Hispanic mothers. Among all mothers who gave birth in the United States in 2006, 59.9% of black women and 76.5% of white women initiated breastfeeding, while 82.1% of Hispanic women reported initiation.³⁰

Maternal Health Progress Review

Advances in several indicators were observed in the PNSS population from 1999 through 2008 (Figure 5).[†] The prevalence of initiation of breastfeeding increased from 49.9% in 1999 to 65.4% in 2008, a relative increase of 31%. The 2008 rate was the highest ever reported. In addition, since 1999, the proportion of women who enroll in the WIC program during their first trimester increased 14%, and the proportion of women who gain inadequate weight during pregnancy decreased 12%.

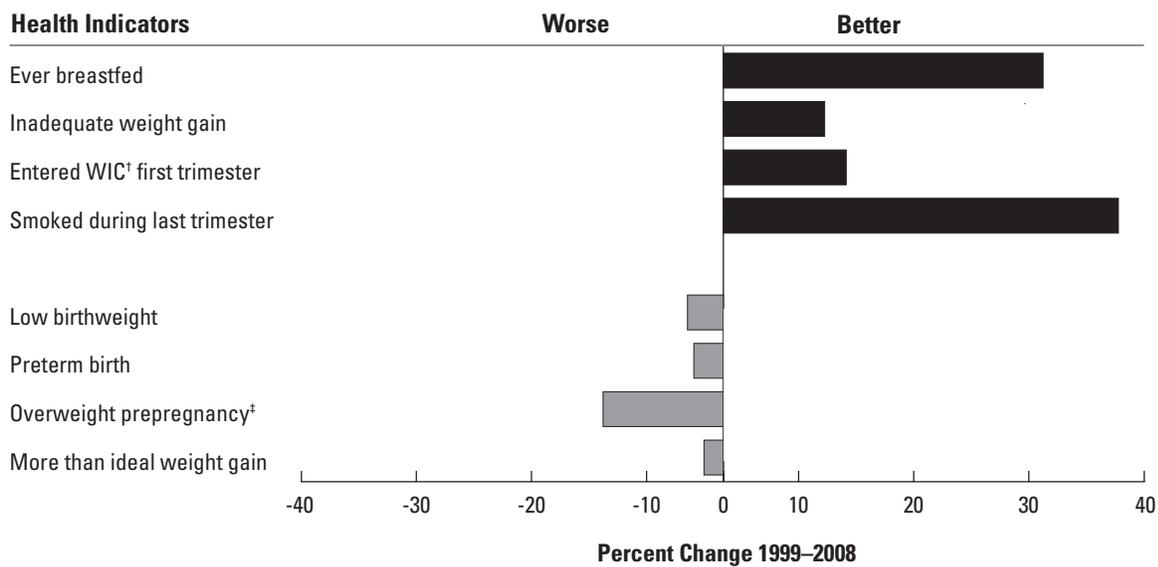
The prevalence of women who smoke during the last trimester of pregnancy has dropped 38% during the past 10 years. The prevalence of women who smoke during the last trimester of pregnancy was 14.2% in 2008, the lowest prevalence ever reported in the PNSS.

The 2008 PNSS report also indicated areas of concern. One area of concern is the 5% increase in preterm births and the 4% increase in low birthweight. The prevalence of iron-deficiency anemia during pregnancy also remains high.

Overweight is a major public health problem that has steadily increased in the United States, and this problem is mirrored in the PNSS population. The proportion of women who are overweight or obese before pregnancy has increased 14%, and the proportion of women gaining more than the IOM's recommended amount of weight gain during pregnancy also increased 3%.

[†] For all trend data comparing 1999 with 2008 in Figure 5 and throughout this publication, contributing participants (states, U.S. territories, and ITOs) change slightly each year. Thus, the differences in prevalence must be interpreted cautiously.

Figure 5. Changes* in maternal and infant health status, 1999–2008



* All trend data in this report are based on participants that vary slightly from year to year. Comparisons must be made with caution.

[†] Special Supplemental Food Program for Women, Infants, and Children.

[‡] Based on definitions of overweight and obese prepregnancy (BMI ≥ 26.1) in a 1990 report by the Institute of Medicine.

Recommendations

The PNSS data indicate that national and state public health programs are needed to support the following activities:

- Implement strategies to continue to reduce the prevalence of tobacco use among pregnant women and women of reproductive age.
- Promote and support breastfeeding through effective programs, medical care systems, work sites, and communities.
- Prevent preterm delivery and low birthweight by providing preconception nutrition, including iron supplementation.
- Conduct outreach activities to promote early identification of pregnancy and early entry into comprehensive prenatal care, including the WIC program.
- Provide information to prenatal participants, especially women who are overweight or obese before pregnancy, about the importance of appropriate weight gain during pregnancy and the health risks of excess weight gain and post partum weight retention.

References

1. Martin JA, Hamilton BE, Sutton PD, Ventura SJ, Menacker F, Kirmeyer S, et al. Births: final data for 2006. *National Vital Statistics Reports* 2009;57(7):1–102. Available at http://www.cdc.gov/nchs/data/nvsr/nvsr57/nvsr57_07.pdf.
2. Doherty DA, Magaan EF, Francis J, Morrison JC, Newnham JP. Pre-pregnancy body mass index and pregnancy outcomes. *International Journal of Gynecology & Obstetrics* 2006;95(3):242–247.
3. Li R, Jewells S, Grummer-Strawn L. Maternal obesity and breast-feeding practices. *American Journal of Clinical Nutrition* 2003;77(4):931–936.
4. Institute of Medicine. *Nutrition During Pregnancy*. Washington, DC: National Academies Press; 1990.
5. Institute of Medicine. *Weight Gain During Pregnancy: Reexamining the Guidelines*. Washington, DC: National Academies Press; 2009.
6. Rooney BL, Schauburger CW. Excess pregnancy weight gain and long-term obesity: one decade later. *Obstetrics & Gynecology* 2002;100(2):245–252.
7. CDC. Recommendations to prevent and control iron deficiency in the United States. *MMWR* 1998;47(RR-3):1–36.
8. Scholl, TO. Iron status during pregnancy: setting the stage for mother and infant. *American Journal of Clinical Nutrition* 2005; 81(5):1218S–1222S.
9. U.S. Department of Health and Human Services. *Healthy People 2010*. Volume II. Washington, DC: U.S. Government Printing Office; 2000.
10. Zhu BP, Rolfs RT, Nangle BE, Horan JM. Effect of the interval between pregnancies on perinatal outcomes. *New England Journal of Medicine* 1999;340(8):589–594.
11. Conde-Agudelo A, Belizán JM. Maternal morbidity and mortality associated with interpregnancy interval: cross sectional study. *BMJ* 2000;321(7271):1255–1259.
12. Institute of Medicine. *WIC Nutrition Risk Criteria: A Scientific Assessment*. Washington, DC: National Academies Press; 1996.
13. Devaney B, Bilheimer L, Schore J. Medicaid costs and birth outcomes: the effects of prenatal WIC participation and the use of prenatal care. *Journal of Policy Analysis and Management* 1992;11(4):573–592.
14. National Center for Health Statistics. *Health, United States, 2009: With Special Feature on Medical Technology*. Hyattsville, MD; 2010.
15. Abrams B. Preventing low birthweight: does WIC work? A review of evaluations of the Special Supplemental Food Program for Women, Infants and Children. *Annals of the New York Academy of Sciences* 1993;678:306–315.
16. Ahluwalia I, Hogan VK, Grummer-Strawn L, Colville WR, Peterson A. The effect of WIC participation on small-for-gestational-age births: Michigan, 1992. *American Journal of Public Health* 1998;88(9):1374–1377.
17. Salihu HM, Aliyu MH, Pierre-Louis BJ, Alexander GR. Levels of excess infant deaths attributable to maternal smoking during pregnancy in the United States. *Maternal and Child Health Journal* 2003;7(4):219–227.
18. Anderson ME, Johnson DC, Batal HA. Sudden infant death syndrome and prenatal maternal smoking: rising attributed risk in the Back to Sleep era. *BMC Medicine* 2005;3:4.
19. U.S. Department of Health and Human Services. *Women and Smoking: A Report of the Surgeon General*. Atlanta: U.S. Department of Health and Human Services, CDC; 2001.
20. Samet JM, Yoon SY, editors. *Women and the Tobacco Epidemic: Challenges for the 21st Century*. Canada: World Health Organization; 2001.
21. U.S. Department of Health and Human Services. *The Health Consequences of Smoking: A Report of the Surgeon General*. Washington, DC: U.S. Department of Health and Human Services; 2004.

22. Hofhuis W, de Jongste JC, Merkus PJ. Adverse health effects of prenatal and postnatal tobacco smoke exposure on children. *Archives of Disease in Childhood* 2003;88(12):1086–1090.
23. U.S. Department of Health and Human Services. *The Health Consequences of Involuntary Exposure to Tobacco Smoke: A Report of the Surgeon General*. Washington, DC: U.S. Department of Health and Human Services; 2006.
24. Mathews TJ, MacDorman MF. Infant mortality statistics from the 2005 period linked birth/ infant death set. *National Vital Statistics Reports*. 2008;57(2):1–32.
25. Goldenberg RL, Culhane JF. Low birth weight in the United States. *American Journal of Clinical Nutrition* 2007;85(2):584S–590S.
26. Hamilton BE, Martin JA, Ventura SJ. Births: preliminary data for 2007. *National Vital Statistics Reports* 2009;57(12):1–23. Available at http://www.cdc.gov/nchs/data/nvsr/nvsr57/nvsr57_12.pdf.
27. Jolly MC, Sebire NJ, Harris JP, Regan L, Robinson S. Risk factors for macrosomia and its clinical consequences: a study of 350,311 pregnancies. *European Journal of Obstetrics, Gynecology, and Reproductive Biology* 2003;11:9–14.
28. March of Dimes. Quick Reference Fact Sheet. Preterm Births. March of Dimes Web site. Available at http://www.marchofdimes.com/professionals/14332_1157.asp.
29. Ip S, Chung M, Raman G, Chew P, Magula N, DeVine D, et al. Breastfeeding and maternal and infant health outcomes in developed countries. *Evidence Report/Technology Assessment* 2007;153:1–186.
30. CDC. Breastfeeding Among Children Born 1999–2006, CDC National Immunization Survey. Available at http://www.cdc.gov/breastfeeding/data/NIS_data/.

