
pregnancy nutrition



Surveillance

1996 Full Report



U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

pregnancy nutrition



S u r v e i l l a n c e

Suggested citation

Centers for Disease Control and Prevention. *Pregnancy nutrition surveillance, 1996 full report*. Atlanta: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, 1998.

Preface

This report summarizes selected indices of nutritional status received from 24 states that contributed to a program of nutrition surveillance in the United States. The report was prepared by the Department of Health and Human Services under the direction of the Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion.

Centers for Disease Control and Prevention	Claire V. Broome, M.D., <i>Acting Director</i>
National Center for Chronic Disease Prevention and Health Promotion	James S. Marks, M.D., M.P.H., <i>Director</i>
Division of Nutrition and Physical Activity	William Dietz, M.D., Ph.D., <i>Director</i>
Maternal and Child Nutrition (MCN) Branch	Laurence Grummer-Strawn, Ph.D., <i>Acting Chief</i>
Technical Information and Editorial Services (TIES) Branch	Christine Fralish, M.L.I.S., <i>Chief</i>

Contributors

MCN Branch

Main author:	Karen Dalenius, M.P.H., R.D., <i>Public Health Nutritionist</i>
Content development:	Laurence Grummer-Strawn, Ph.D., <i>Acting Chief</i> Diane Clark, M.P.H., R.D., <i>Deputy Branch Chief</i> Mary Cogswell, Dr.P.H., R.N., <i>Epidemiologist</i> Ibrahim Parvanta, M.S., <i>Public Health Nutritionist</i> Bettylou Sherry, Ph.D., R.D., <i>Epidemiologist</i>
Data analysis:	Jimmy Simmons, <i>Computer System Analyst</i> Sandy Jewell, M.S., M.P.A., <i>Statistician</i>
Graphics support:	U. Agnes Trinh, B.A., <i>Intern, Association of Schools of Public Health</i>

TIES Branch

Editor:	Barbara Gray, M.Ln., <i>Writer-Editor</i>
---------	---

Contents

- Summary** 1
- Introduction** 3
 - Features of the System 3
 - Limitations of the System 5
- State Results** 7
 - Maternal Demographic Characteristics 7
 - Race or Ethnicity 7
 - Age 7
 - Marital Status 8
 - Education 9
 - Maternal Behavioral and Nutritional Risk Factors 9
 - Prenatal Care 9
 - Entry to WIC Program 10
 - Prepregnancy Weight Status 11
 - Gestational Weight Gain 13
 - Anemia 15
 - Cigarette Smoking 17
 - Alcohol Use 18
 - Birth Outcomes 19
 - High Birthweight 19
 - Low Birthweight 19
 - Prematurity 23
 - Infant-Feeding Practices 24
 - Breastfeeding 24
- Conclusions and Recommendations** 27
 - National and State Nutritional and Behavioral Risk Factor Reduction 27
 - Nutritional Interventions 27
 - Behavioral Interventions 28
 - Nutrition Services and Research 28
 - National and State Nutrition Monitoring 28
- References** 29

Summary

Maternal health behaviors, including nutrition practices, contribute to pregnancy outcome and maternal and infant well-being. The leading causes of low birthweight, infant morbidity, and infant mortality are closely associated with behavioral choices. Nutrition-related factors that affect maternal and infant health include quality of maternal diet, prepregnancy weight, weight gain during pregnancy, anemia, and infant-feeding method. Other influential behavioral factors include alcohol use, tobacco use, and time of entry to prenatal care. Participation in food assistance programs, such as the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC program), has a positive effect on pregnancy outcome. In addition, birthweight is affected by many sociodemographic factors, including maternal race or ethnicity, socioeconomic status, age, and marital status.

Few national data are continuously collected on the distribution of these factors among pregnant women in the general population. The CDC Pregnancy Nutrition Surveillance System (PNSS) has monitored behavioral and nutritional risk

factors among low-income pregnant women enrolled in public health programs in participating states since 1979. This report presents 1996 data and highlights trends from 1989 to 1996. The states contributing to the system have varied over this period. In 1996, the 24 states that participated in the surveillance system contributed over 552,000 records. Data were complete for many data elements but incomplete for others (such as smoking status and alcohol use). Caution is recommended in interpreting the results for these data elements.

In the 1996 PNSS, 26% of mothers were teenagers. About 75% of mothers enrolled in the WIC program while pregnant; the proportion entering the program in the first trimester of pregnancy increased from 1989 to 1996. Prepregnancy body mass index (BMI) changed markedly during the surveillance period; the prevalence of overweight (BMI>26.0) steadily increased from 1989 to 1996. In the 1996 PNSS, 16% of women were underweight when they became pregnant, and 32% gained less weight during pregnancy than is recommended. Both of these factors were associated with risk for having a

low-birthweight infant. In 1996, 8%, 12%, and 29% of women had anemia in the first, second, and third trimesters, respectively. These findings may indicate the need for improved iron nutrition among low-income women. About 23% of women smoked during pregnancy. Rates of maternal behavioral and nutritional risk factors varied widely by state.

In 1996, just over 8% of infants born to women in the PNSS were low birthweight (<2,500 g) and about 9% were high birthweight (>4,000 g). The proportion of low-birthweight infants remained quite steady during the surveillance period. About 47% of infants in the 1996 PNSS were breastfed in the early postpartum period.

A comparison of the PNSS data with the year 2000 national health objectives shows that the objective for decreasing the incidence of very low birthweight babies has nearly been met in the PNSS population. However, objectives pertaining to teenage pregnancy, prepregnancy overweight among women aged 20 years or older, minimum recommended weight gain during pregnancy, prevention of anemia among black women in the third trimester, smoking cessation during pregnancy, decreased incidence of low birthweight, and increased breastfeeding have not been achieved. To meet the nation's objectives for maternal and child nutrition, concerted efforts are needed to convey nutrition and health promotion messages to women and to strengthen delivery of support services.

Introduction

Features of the System

The CDC Pregnancy Nutrition Surveillance System (PNSS) monitors the prevalence of nutrition problems and behavioral risk factors among women at high risk for adverse pregnancy outcomes who are enrolled in public health programs in participating states. The PNSS collects prenatal and postpartum information about these women and outcome information about their infants. These data are contributed by public health programs (such as the Special Supplemental Nutrition Program for Women, Infants, and Children [WIC program] and prenatal clinics funded by the Maternal and Child Health Services Block Grant) to state or tribal governments, which in turn aggregate the data and submit them to CDC quarterly. Women in these programs have a family income near the poverty level, as established by federal and state governments.

The PNSS was enhanced in 1989 when several variables were added to the system. The demographic data collected include maternal birth date, race or ethnicity, marital status, and educational level. Information about monthly income,

household size, and participation in food and medical assistance programs (e.g., Food Stamp Program or Medicaid) may be collected as optional items. Other data collected include mother's height and prepregnancy weight, hemoglobin or hematocrit level, total weight gain during pregnancy, parity, and estimated initiation of prenatal care. Information is collected on smoking and alcohol consumption three months before, during, and after pregnancy. Data collected about infants include date of birth, birthweight, number of siblings during same birth, sex, status at birth and at the postpartum visit, breastfeeding status, and age at introduction to formula (1). These maternal and infant data are used for monitoring progress toward achieving year 2000 national health objectives.

During 1996, 21 states, the District of Columbia, and two tribal governments participated in the PNSS. An additional eight states, one tribal government, Puerto Rico, and American Samoa have since begun implementing the PNSS (Figure 1). All contributors are hereafter referred to as "states."

Figure 1.
Contributors to the Pregnancy Nutrition Surveillance System (PNSS), 1996

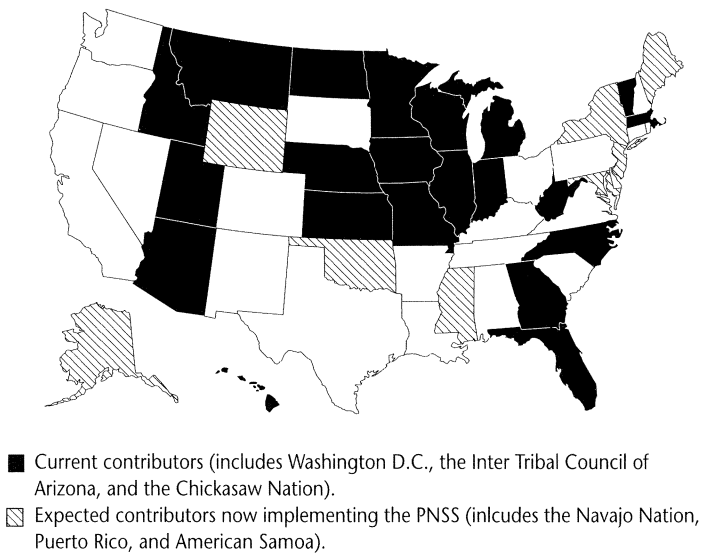


Table 1.
Number of records in the 1996 PNSS, by state

State	Total
Arizona	16,429
Chickasaw Nation	463
Florida	40,019
Georgia	53,702
Hawaii	9,053
Idaho	7,722
Illinois	73,616
Indiana	40,341
ITCA*	2,460
Iowa	14,061
Kansas	13,849
Massachusetts	32,889
Michigan	58,819
Minnesota	20,930
Missouri	43,299
Montana	3,580
Nebraska	7,358
North Carolina	51,547
North Dakota	2,639
Utah	16,846
Vermont	3,159
Washington, D.C.	837
West Virginia	14,073
Wisconsin	24,782
ALL STATES	552,472

*Inter Tribal Council of Arizona.

The number of surveillance records has increased from less than 298,000 in 1989 to more than 552,000 in 1996 (Table 1). The WIC program, which contributed over 97% of the records in 1996, has consistently been the primary source of surveillance records.

CDC generates annual tables for each state agency that summarize nutritional status and behavioral risk factors by age and

race or ethnicity. Additional tables are produced for participating counties and clinics. These data provide state and community health professionals with information for program planning and intervention. The system helps states build their capacity for monitoring pregnancy-related risk factors and birth outcome.

Limitations of the System

The criteria for women's eligibility differ among public health programs, and the data collection methods differ among health clinics. Consequently, the quantity and quality of data differ substantially among variables in the PNSS. Some women who are served by programs while pregnant cannot be served postpartum because of enrollment policies. Some women move into or out of a service area while pregnant (2). In addition, because women come to clinics at different times during and after their pregnancies, information is not always available for the complete pregnancy of all women. In 1996, about 66% of records included both prenatal and postpartum data.

CDC evaluates the quality of the data submitted and sends problematic data back to the states for correction. CDC also evaluates the quantity of missing data.

In 1996, data for specific variables were missing from more than 20% of records from one or more states. The states in question are indicated on the figures throughout the report. In addition, about 28% of all records lacked data on smoking before pregnancy and 32% on alcohol use before and during pregnancy. The effect of the missing data on the results was not assessed; however, bias may have been introduced. *Consequently, care must be taken in interpreting some data for specific states and results for the variables noted above.*

Other factors that can affect estimates include changes in the number of states reporting data to the system and variability in program enrollment criteria between states (3). Because not all low-income women participate in programs that contribute data to the PNSS, this system does not represent all low-income women

in participating states.¹ Further, because many states do not participate in the PNSS, the data do not reflect all such women in the United States, at least in part due to large demographic and other differences between states (4).

When using PNSS data to assess progress in achieving year 2000 national health objectives, limitations of the system must be considered, but the estimates are nonetheless useful. Although the objectives are for the general U.S. population, a rigorous test of the nation's progress in maternal and child health is in the achievement of objectives in populations at increased risk for poor pregnancy outcome and infant morbidity.

Throughout the report, PNSS rates are also compared with similar indices from other data sources to illustrate differences between the PNSS population and the

general U.S. maternal population.

Estimates of key indicators, such as low birthweight and maternal smoking, are comparable between the PNSS and other sources (3). In addition, because the PNSS data come from many clinics across the country, the aggregated data are not subject to temporal changes among subsets of clinics. Thus, the system is reliable for determining trends (3).

¹To be eligible for the WIC program, for example, a pregnant woman must have one or more established nutritional needs and a household income <185% of the federal poverty level. Few women who are eligible by income are found ineligible for other reasons. The U.S. Department of Agriculture, which administers the program, estimates that approximately 80% of all women fully eligible for the program would participate if funds were available to permit full participation. In 1996, an estimated 62% of pregnant women who were fully eligible for the WIC program nationwide participated in the program (5).

State Results

Maternal Demographic Characteristics

The main demographic variables influencing pregnancy outcome are race or ethnicity, maternal age, marital status, and socioeconomic status (6).

Race or Ethnicity

In 1996, 56% of women in the PNSS were white, 24% black, 15% Hispanic, 2% American Indian, 2% Asian or Pacific Islander, and 1% of all other or unspecified race or ethnicity (Figure 2). The distribution of this variable was wide among states.

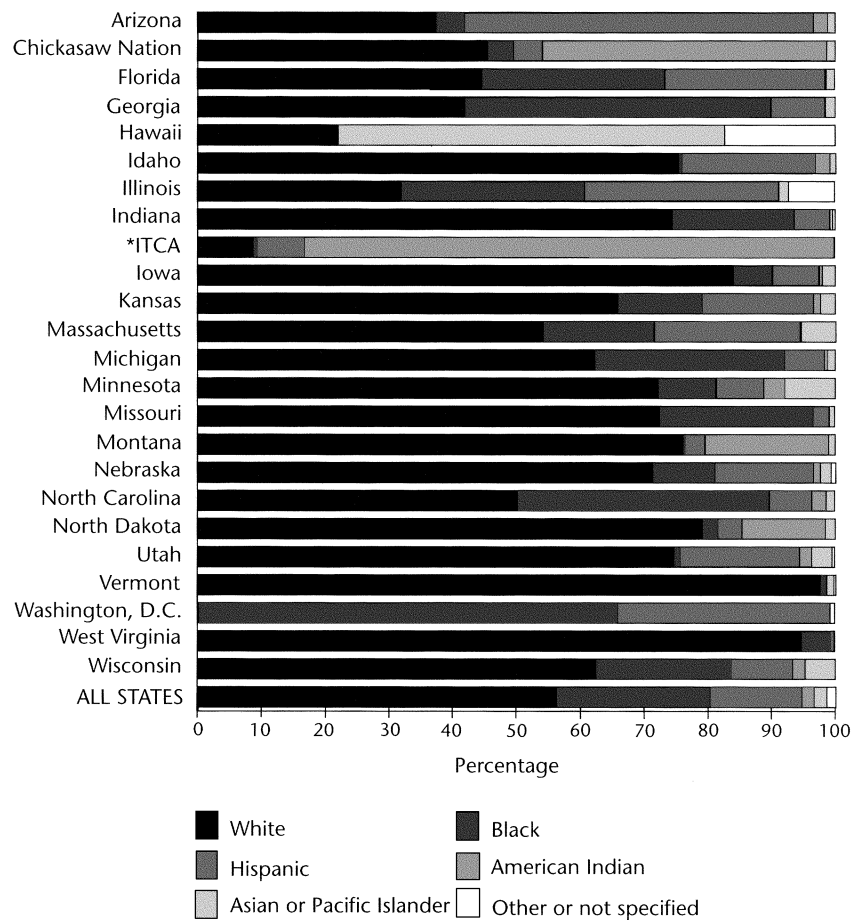
The proportion of white women (56%) was lower and the proportion of black women (24%) was higher in the 1996 PNSS than in the general population of U.S. women who gave birth in 1996 (79% and 15%, respectively) (7).

Age

The proportion of teenage mothers in the PNSS has remained stable since 1989. In 1996, 26% of all mothers were teenagers, and most of these mothers were aged 16 to 19 years (Figure 3). The percentage of births to teenage mothers ranged from 19% to about 29%.

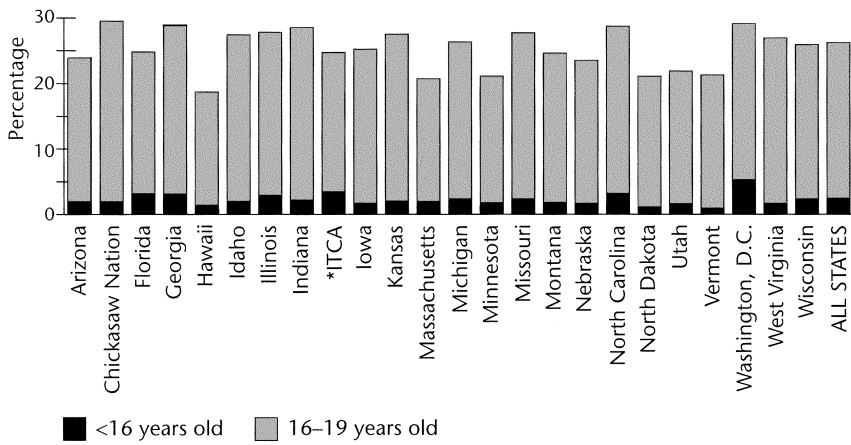
Figure 2.

Mother's race or ethnicity, by state, 1996 PNSS



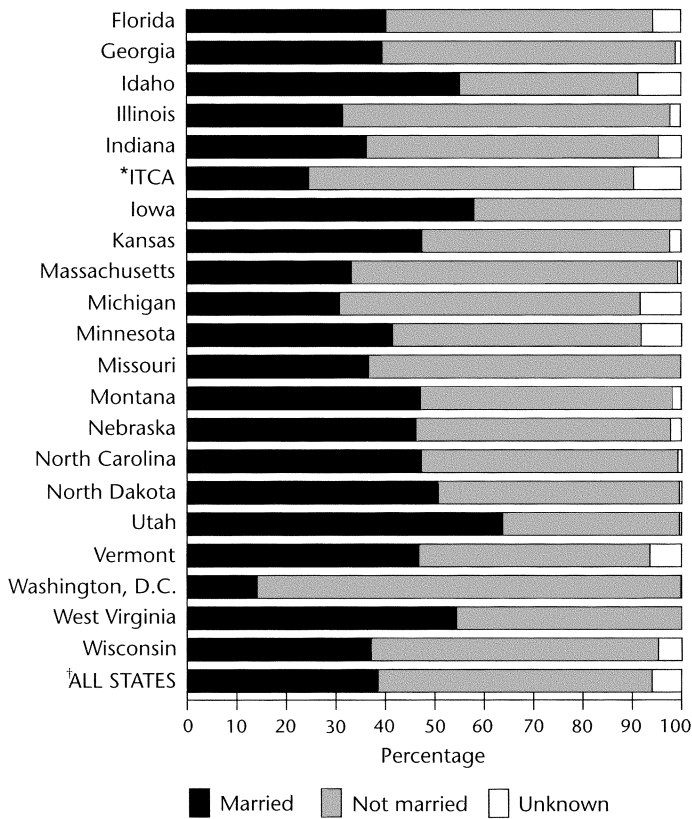
*Inter Tribal Council of Arizona.

Figure 3.
Percentage of births to teenage mothers,
by state, 1996 PNSS



*Inter Tribal Council of Arizona.

Figure 4.
Mother's marital status, by state,
1996 PNSS



*Inter Tribal Council of Arizona.

†Data not available for Arizona, Chickasaw Nation, or Hawaii.

In the United States, about 13% of all women who gave birth in 1996 were aged 19 years or less, and about 5% were aged 17 years or less (7). The year 2000 health objectives for the nation call for a reduction in teenage pregnancies to no more than 5% among girls aged 17 years or younger (8).

Fifty-seven percent of women in the 1996 PNSS were 20 to 29 years, 16% were 30 to 39 years, and 1% were 40 to 49 years.

More than one-fourth of all mothers in the 1996 PNSS were teenagers.

Marital Status

In the 1996 PNSS, 55% of mothers were unmarried and 39% were married; marital status was unknown for 6% (Figure 4). Data greatly varied by state; compared with mothers in Utah, about twice as many mothers in Illinois, the Inter Tribal Council of Arizona, Michigan, and Washington, D.C., were unmarried.

For comparison, about 32% of all U.S. women who gave birth in 1996 were unmarried (7).

Fifty-five percent of all mothers in the 1996 PNSS were unmarried.

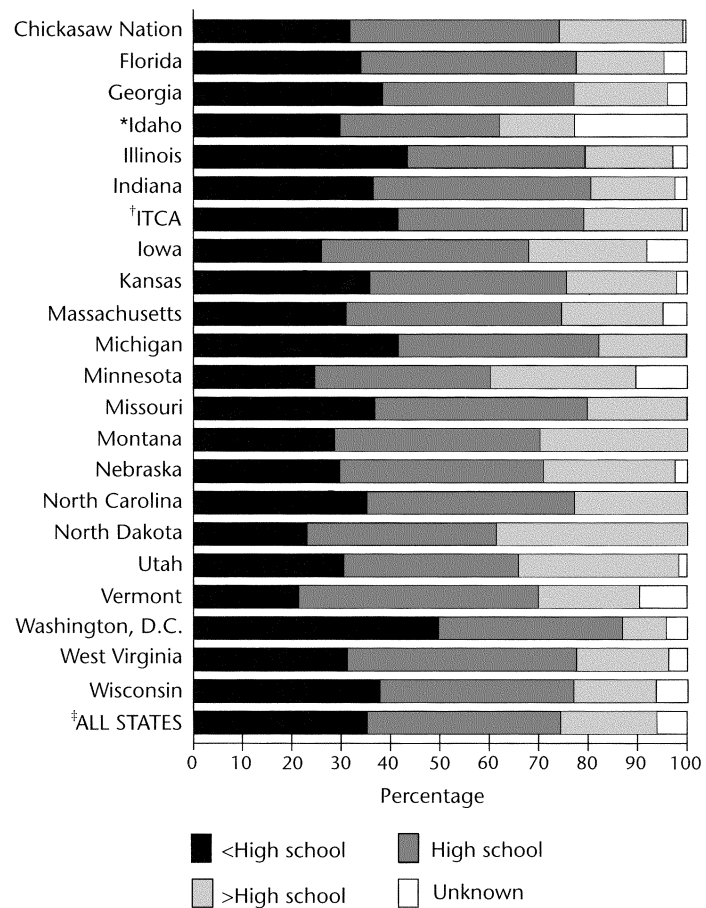
Education

Mother's level of education can be used as a proxy for socioeconomic status (6). Twenty-three percent of all U.S. women who gave birth in 1995² had less than a high school education (9). In the 1996 PNSS, this proportion was 35% (Figure 5), ranging from 21% in Vermont to more than 40% in Illinois, the Inter Tribal Council of Arizona, Michigan, and Washington, D.C. The proportion has changed very little since 1989.

□ Thirty-five percent of all mothers in the 1996 PNSS had less than a high school education.

² Data not available for 1996.

Figure 5.
Mother's educational level,
by state, 1996 PNSS



*Data for this variable were missing from more than 20% of records.
 †Inter Tribal Council of Arizona.
 ‡Data not available for Arizona and Hawaii.

Maternal Behavioral and Nutritional Risk Factors

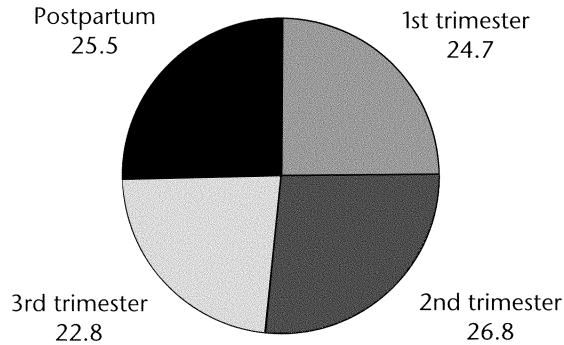
Prenatal Care

The quality, quantity, and timing of prenatal care influence pregnancy outcome. Inadequate care substantially increases a woman's risk for poor pregnancy course and outcome. Lack of prenatal care is closely associated with other risk factors, such as teenage birth, low income, and substance abuse. The earlier prenatal care is begun, the less

likely a woman is to have a low-birthweight infant (10). The year 2000 national health objectives call for 90% of pregnant women to receive prenatal care in the first trimester (8).

Seventy-six percent of women in the 1996 PNSS reported having begun prenatal care in the first trimester, 15% in the second trimester, and 2% in the third trimester.

Figure 6.
Percentage of women by time of entry
in the WIC program,* 1996 PNSS



*Data not available for Arizona, Florida, North Dakota, and Washington, D.C.

Table 2.
Percentage of women by time of entry in the
WIC program, by state, 1996 PNSS

State	1st trimester	2nd trimester	3rd trimester	Postpartum
Chickasaw Nation	33.3	26.8	16.5	23.4
Georgia	27.7	18.5	8.9	44.8
Hawaii	8.0	34.3	25.6	32.2
Idaho	26.7	37.1	22.8	13.4
Indiana	29.8	28.5	16.7	25.0
ITCA*	24.0	35.9	21.3	18.8
Iowa	25.8	29.3	17.6	27.2
Kansas	27.8	27.6	20.5	24.0
Massachusetts	30.3	32.5	17.9	19.3
Michigan	26.3	35.5	23.1	15.1
Minnesota	23.9	32.9	22.6	20.6
Missouri	36.5	28.0	15.0	20.4
Montana	37.5	40.0	22.5	0.0
Nebraska	22.8	29.6	22.6	25.0
North Carolina	29.6	34.8	20.2	15.4
Utah	29.9	29.1	15.9	25.0
Vermont	32.4	34.6	18.4	14.6
West Virginia	38.4	29.0	17.0	15.6
Wisconsin	30.3	30.5	18.1	21.1
†ALL STATES	24.7	26.8	22.8	25.5

*Inter Tribal Council of Arizona.

†Data not available for Arizona, Florida, Illinois, North Dakota, and Washington, D.C.

Six percent reported no prenatal care. Teenagers were less likely than older women to begin prenatal care in the first trimester, and white women were more likely than women of other races or ethnicities to do so.

Women who enter the WIC program late in pregnancy are likely to enter prenatal care late in pregnancy. Because timing of WIC entry among pregnant women varies by state, prenatal care rates not adjusted for time of entry are not comparable among states.

Entry to WIC Program

Dietary intake and prenatal weight gain are better for women who enroll in the WIC program than for those who do not (11, 12). Participants are more likely than nonparticipants to receive prenatal care early, and their infants are less likely to be premature and low birthweight. All benefits are most apparent for women who enroll early in pregnancy (11, 12).

Nearly 25% of women in the 1996 PNSS enrolled in the WIC program during their first trimester, 27% in their second trimester, and over 48% in their third trimester or after delivery (Figure 6). Patterns of enrollment varied by state (Table 2).

The proportion of women who enroll in the WIC program early in pregnancy has improved. In 1989, 13% of women enrolled during the first trimester, but nearly 25% did so in 1996 (Figure 7).

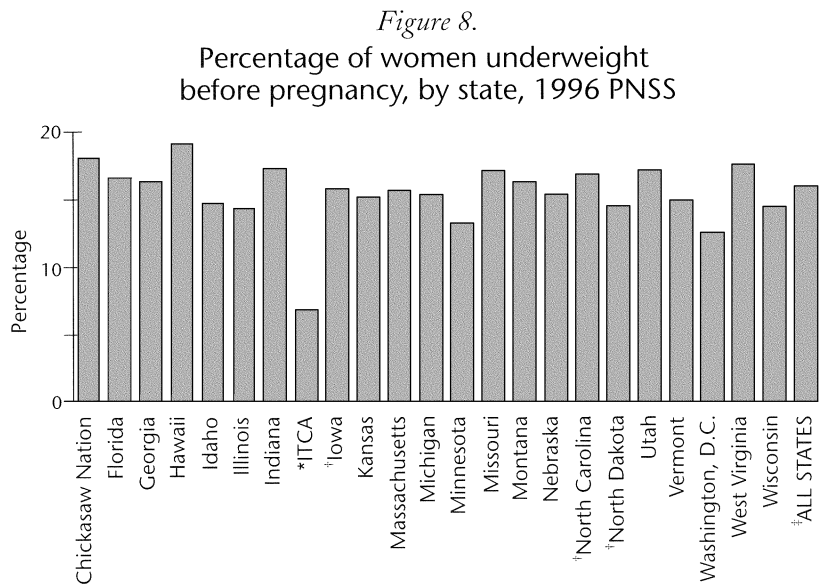
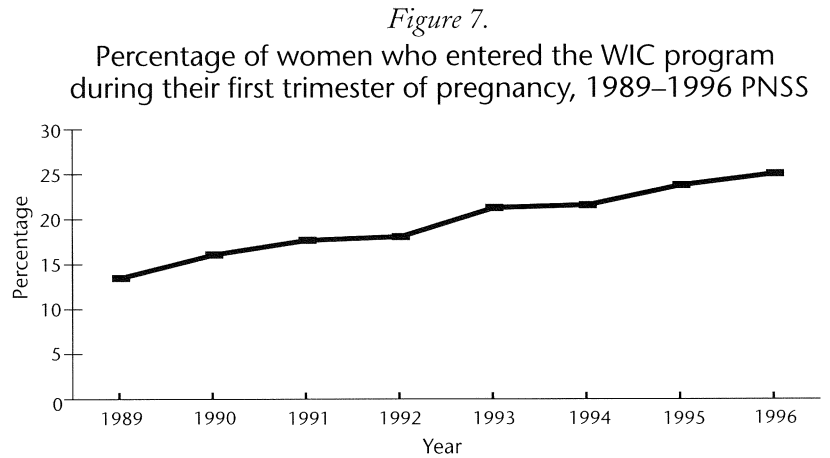
- The proportion of pregnant women who enrolled in the WIC program during their first trimester has increased during the past seven years.
- Only 52% of women in the 1996 PNSS enrolled in the WIC program during their first or second trimester.

Prepregnancy Weight Status

Prepregnancy weight is a determinant of infant birthweight. Studies suggest a strong association between prepregnancy underweight and having a low-birthweight baby (13). Overweight women, who are at increased risk for pregnancy-induced hypertension and gestational diabetes, are also more likely to deliver by cesarean section and to have a high-birthweight infant (14).

Body mass index (BMI), based on measured height and weight, was calculated for each woman in the 1996 PNSS. Women were classified by the Institute of Medicine's BMI categories: underweight, <19.8; normal weight, 19.8 to 26.0; overweight, 26.1 to 29.0; very overweight, >29.0 (15). For this report, women in the last two categories were combined.

Sixteen percent of women in the 1996 PNSS were underweight, 48% were normal weight, and 36% were overweight. Rates of underweight ranged from 7% for women in the Inter Tribal Council of Arizona to 19% for women in Hawaii (Figure 8). The



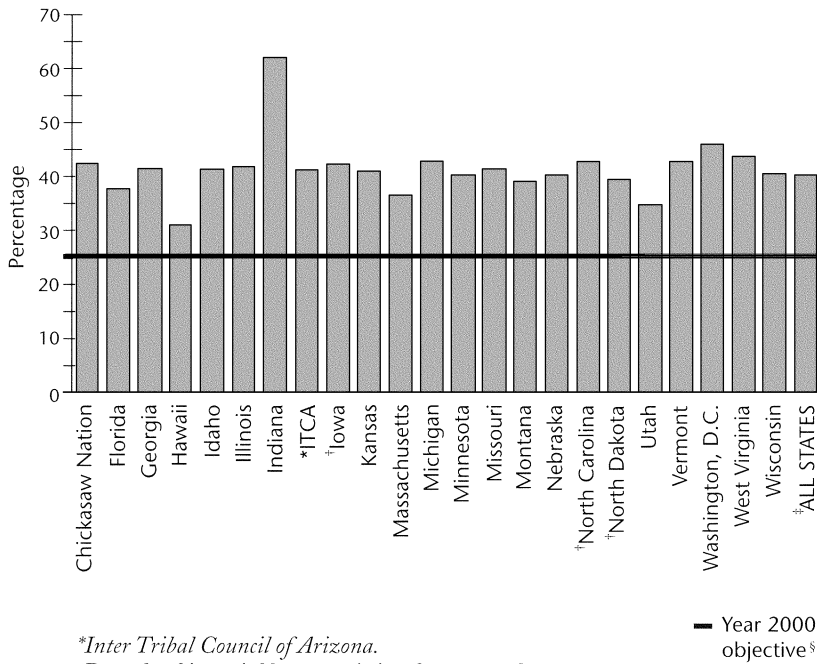
*Inter Tribal Council of Arizona.

[†]Data for this variable were missing from more than 20% of records.

[‡]Data not available for Arizona.

Figure 9.

Percentage of prepregnancy overweight among women aged 20 years or older, by state, 1996 PNSS



*Inter Tribal Council of Arizona.

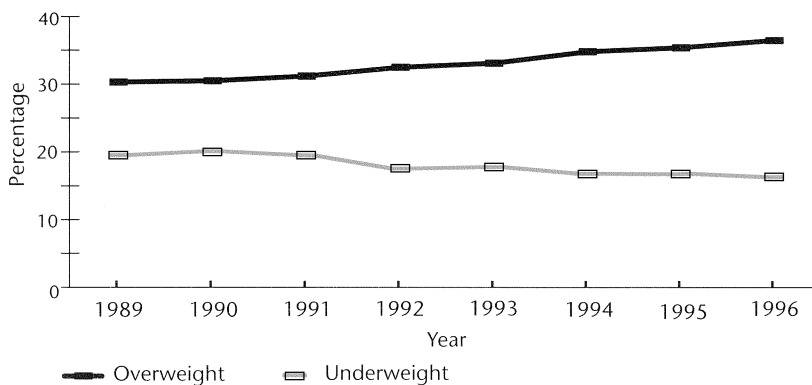
†Data for this variable were missing from more than 20% of records.

‡Data not available for Arizona.

§Reduce overweight to less than 25% among low-income women aged 20 years or older.

Figure 10.

Prevalence of prepregnancy overweight and underweight, 1989–1996 PNSS



prevalence of overweight among women aged 20 years or older (40%) exceeded the year 2000 target (25%) for low-income women in this age group (8). The objective was not achieved in the PNSS population in any state (Figure 9).

The prevalence of prepregnancy overweight among women in the PNSS increased from nearly 30% in 1989 to 36% in 1996; the prevalence of underweight declined from 19% to almost 16% in the same period (Figure 10). This finding is consistent with trends of increasing mean BMI among women in the United States (16, 17).

The percentage of women in each weight category varied substantially by race or ethnicity and age. Women who were Asian or Pacific Islander, white, or under 20 years of age were more likely to be underweight. Women who were American Indian, black, or over 29 years of age were more likely to be overweight (Table 3).

Caution is needed in interpreting prepregnancy weight status, which is based on self-reported prepregnancy weight data that may be biased (18). For example, overweight women are more likely than underweight women to underestimate their prepregnancy weight. Similar patterns of underreporting of past weight have been reported among nonpregnant women as well (19).

- In the 1996 PNSS, 16% of women were underweight and 36% were overweight before pregnancy.
- The proportion of overweight women aged 20 years or older in the 1996 PNSS (40%) exceeded the year 2000 target (25%).
- The prevalence of overweight among women in the PNSS has steadily increased during the past seven years.
- Mothers who were Asian or Pacific Islander, white, or young were more likely than other mothers to be underweight.

Table 3.
Percentage of women, by prepregnancy weight status, race or ethnicity, and age, 1996 PNSS

	Under-weight	Normal weight	Over-weight
Race or ethnicity			
White	17.9	47.6	34.5
Black	12.8	45.5	41.6
Hispanic	11.4	53.4	35.2
American Indian	10.4	41.7	47.9
Asian or Pacific Islander	24.7	53.9	21.4
Age (years)			
<16	25.4	57.4	17.1
16-19	22.0	53.0	24.9
20-29	14.6	46.7	38.8
30-39	10.4	44.6	45.1
≥40	7.8	42.8	49.4

Gestational Weight Gain

The Institute of Medicine recommends prenatal weight gain as follows: 28 to 40 pounds for underweight women, 25 to 35 pounds for women of normal weight, and 15 to 25 pounds for overweight women (15). Women who gain less than ideal weight during pregnancy are at increased risk for preterm birth and delivery of a low-birthweight infant; women who gain more than ideal weight are at increased risk for delivery of a high-birthweight infant. Women who gain excess weight may also have a difficult delivery and difficulty returning to their prepregnancy weight after delivery (15).

In the 1996 PNSS, about 32% of women gained less weight during pregnancy than is recommended, about 40% gained the

recommended amount, and about 28% gained more weight than is recommended. Hispanic, black, and Asian or Pacific Islander women were likely to gain less than the recommended weight, whereas white women were likely to gain more weight than recommended. Women aged 40 to 49 years were more likely than younger women not to gain adequate weight (Table 4). The proportion of women who gained less than or greater than recommended weight has remained steady since 1989.

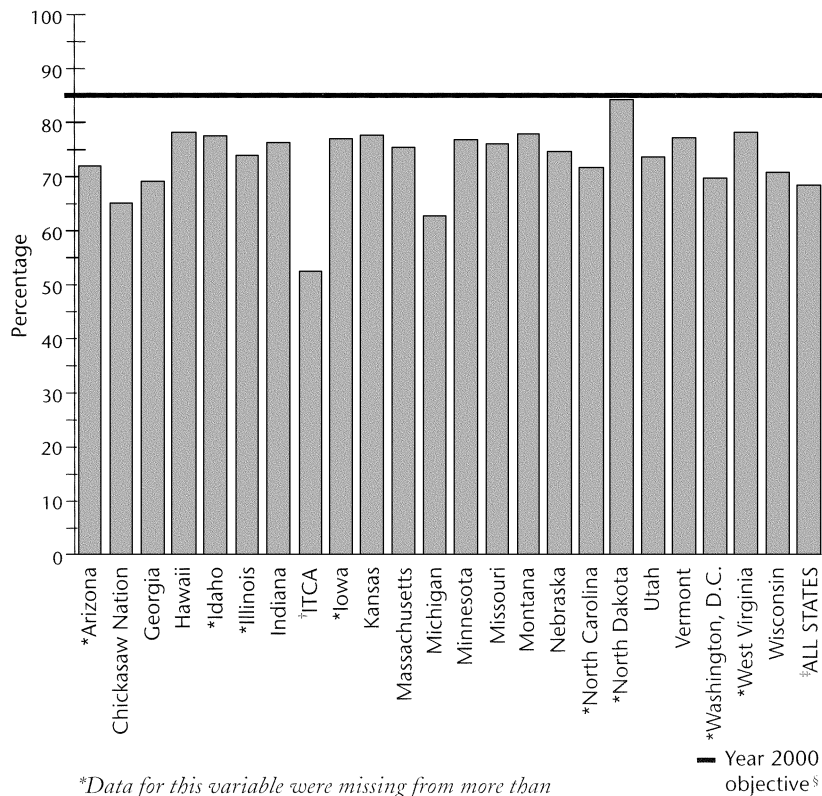
Table 4.
 Percentage of women, by recommended gestational weight gain, race or ethnicity, and age, 1996 PNSS

	Less than recommended	Recommended	More than recommended
Race or ethnicity			
White	27.5	41.8	30.7
Black	38.4	38.6	23.0
Hispanic	39.9	37.0	23.1
American Indian	31.3	42.5	26.2
Asian or Pacific Islander	35.9	39.6	24.5
Age (years)			
<16	32.6	33.1	34.3
16-19	29.3	37.3	33.4
20-29	31.3	41.8	26.9
30-39	35.7	41.5	22.8
≥40	40.2	41.2	18.6

The year 2000 objectives call for an increase to 85% in the proportion of women who gain the minimum recommended weight during pregnancy (8). About 68% of women in the 1996 PNSS gained the minimum amount. The objective was not achieved in the PNSS population in any state (Figure 11).

Caution is needed in interpreting gestational weight gain because, like prepregnancy weight status, the results are based on self-reported data that may be biased.

Figure 11.
 Percentage of women who gained the minimum recommended weight during pregnancy, by state, 1996 PNSS



- Nearly 68% of women in the 1996 PNSS gained the minimum recommended amount of weight during pregnancy, but the year 2000 goal is 85%.
- 32% of women in the PNSS gained less than recommended weight during pregnancy and were at risk for preterm birth and delivery of a low-birthweight infant.
- Nearly 30% of women in the PNSS gained more than recommended weight during pregnancy and were at risk for delivery of a high-birthweight infant.

*Data for this variable were missing from more than 20% of records.

¹Inter Tribal Council of Arizona.

²Data not available for Florida.

[§]Increase to at least 85% the proportion of mothers who achieve the minimum recommended weight gain during their pregnancies.

Anemia

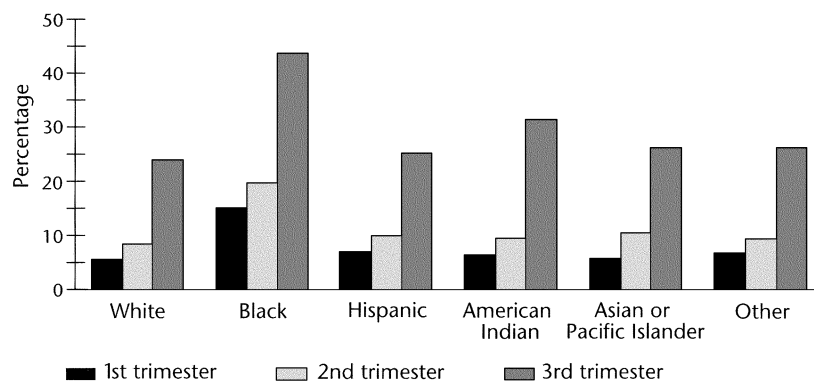
The most common nutritional deficiency during pregnancy is iron deficiency. Less than half of nonpregnant women have iron stores adequate to meet their requirements should they become pregnant. In addition, the high iron requirements during pregnancy are difficult to meet by dietary sources; hence, iron supplementation is required (20). Because of poor compliance (related to side effects) or late enrollment in prenatal care, many women do not receive adequate iron (15). Iron-deficiency anemia during the first two trimesters of pregnancy has been associated with inadequate gestational weight gain, a twofold risk for preterm delivery, and a threefold risk for delivering a low-birthweight infant (21).

Anemia, defined by a low hemoglobin (Hgb) or low hematocrit (Hct) level, is an indicator of iron deficiency. The CDC reference criteria for anemia during pregnancy are as follows: first trimester, Hgb <11.0 g/dL or Hct <33%; second trimester, Hgb <10.5 g/dL or Hct <32%; third trimester, Hgb <11.0 g/dL or Hct <33% (22).

In the 1996 PNSS, 8% and 12% of women had anemia in the first and second trimesters, respectively. Substantially more women (29%) had anemia in the third trimester. This pattern of increasing prevalence of anemia may suggest worsening iron status throughout pregnancy.

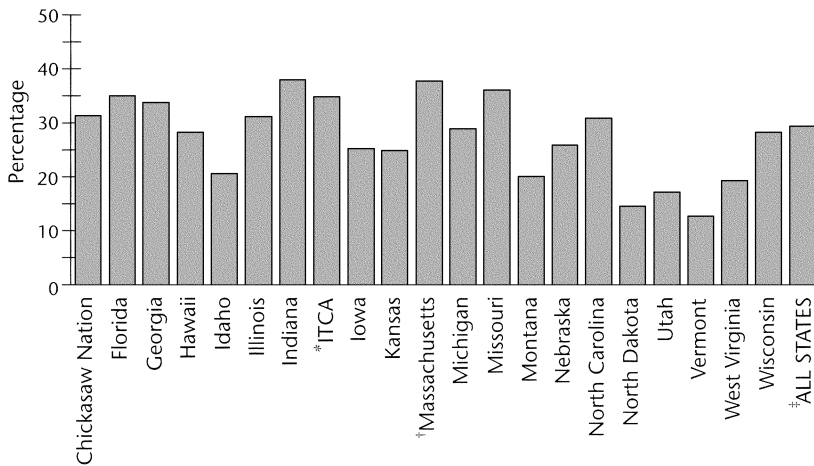
In all trimesters of pregnancy, the rate of anemia was higher among teenage mothers than older mothers. The rate was also higher for black women than for women of other racial or ethnic groups (Figure 12). The year 2000 objectives call for a reduction in anemia to 20% among low-income black women in the third trimester of pregnancy (8). This objective is far from being met in the 1996 PNSS population: 44% of black women had anemia during the third trimester. Although rates were lowest for white women, 24% had anemia in the third trimester. Rates of third-trimester anemia ranged from 13% to 15% in some states to 36% to 38% in others (Figure 13). The third-trimester rates are for women who enrolled in the WIC program or another

Figure 12.
Prevalence of anemia by trimester of pregnancy and race or ethnicity, 1996 PNSS*



*Data not available for Arizona.

Figure 13.
Prevalence of third-trimester anemia,
by state, 1996 PNSS

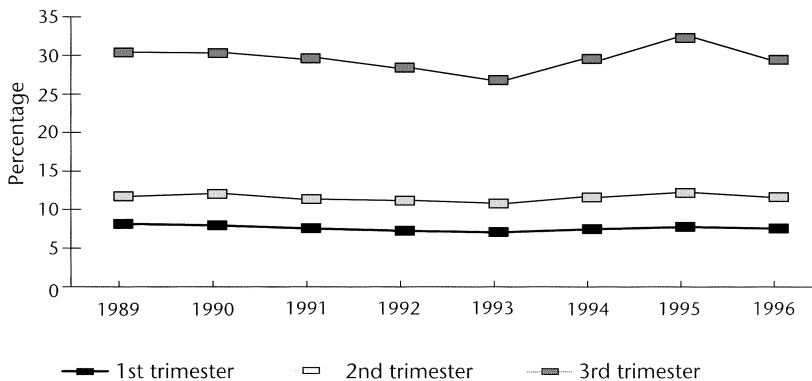


*Inter Tribal Council of Arizona.

[†]Data for this variable were missing from more than 20% of records.

[‡]Data not available for Arizona, Minnesota, and Washington, D.C.

Figure 14.
Prevalence of anemia by trimester
of pregnancy, 1989–1996 PNSS



public health program during their third trimester. These women are likely to have entered prenatal care late in pregnancy.

The Third National Health and Nutrition Examination Survey (NHANES III) found that iron deficiency is more common among women who are of racial or ethnic minority groups, are poor, have less than a high school education, or have had two or three prior pregnancies (23). Most women in the PNSS meet two or more of these criteria.

No change in the prevalence of iron deficiency or iron-deficiency anemia among young women is evident in NHANES data for the past 18 years (23). The prevalence of anemia during pregnancy has not changed among women in the PNSS in the past seven years (Figure 14).

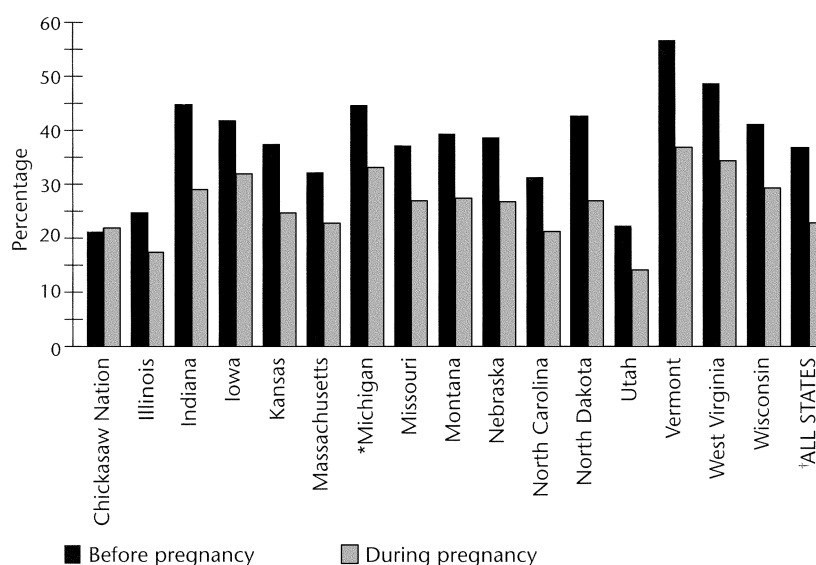
- About 8%, 12%, and 29% of women in the 1996 PNSS had anemia in the first, second, and third trimesters, respectively.
- The pattern of increasing prevalence of anemia as pregnancy progresses may suggest worsening iron status throughout pregnancy.
- The year 2000 national health objectives call for reducing anemia among low-income black women in the third trimester of pregnancy to at least 20%, but the prevalence was 44% in the 1996 PNSS.

Cigarette Smoking

If all pregnant women stopped smoking, the number of fetal and infant deaths could be reduced by about 10% (24). Maternal smoking during pregnancy doubles the risk of delivering a low-birthweight infant and is a contributing factor to 20% to 40% of low-birthweight infants born in the United States (25). Maternal smoking doubles the risk for sudden infant death syndrome and increases the risk for spontaneous abortion (26, 27). Smoking by women over 25 years of age is associated with a higher incidence of preterm delivery, when compared with smoking by women aged 25 years or younger (28). Passive smoke exposure among pregnant women who do not smoke may increase the risk of having a low-birthweight infant (29). Further, the effect of smoking during pregnancy on birthweight depends on not only the number of cigarettes smoked but also the tar, nicotine, and carbon monoxide yield of the cigarettes smoked (30).

About 37% of women in the 1996 PNSS reported having smoked before pregnancy, and about 23% reported smoking during pregnancy (Figure 15). Of these women, 75% reported smoking less than one-half pack per day, 22% reported smoking one-half to one pack per day, and 3% reported smoking more than one pack. In the 1996 PNSS, the highest prevalence of self-reported smoking during pregnancy was found among white women, women aged 30-39 years, women with a high school education or less education, and unmarried women (Table 5).

Figure 15.
Prevalence of smoking, by pregnancy status and state, 1996 PNSS



*Data for this variable were missing from more than 20% of records.
†Data not available for Arizona, Florida, Georgia, Hawaii, Idaho, Inter Tribal Council of Arizona, Minnesota, and Washington, D.C.

Table 5.
Percentage of women who smoked during pregnancy, by selected characteristics, 1996 PNSS

Characteristic	Percentage
Race or ethnicity	
White	32.9
Black	11.9
Hispanic	6.0
American Indian	21.7
Asian or Pacific Islander	3.0
Other or not specified	7.1
Age (years)	
<16	13.9
16-19	21.8
20-29	22.5
30-39	26.9
≥40	13.9
Educational level	
<High school	23.7
High school	22.7
>High school	11.6
Unknown	17.1
Marital status	
Married	19.0
Not married	25.0
Unknown	25.5

Although 28% of records lacked data on smoking before pregnancy, the overall results were comparable with those from other sources. For example, in the 1995 National Health Interview Survey, nearly 23% of women reported smoking (31). The prevalence was higher for women aged 25 to 44 years (nearly 27%), women with 9 to 11 years of education (about 34%), and women below the poverty level (almost 30%) (31).

The year 2000 national health objectives call for a reduction in smoking prevalence to no more than 10% among pregnant women (8).

- Over one-third of women in the 1996 PNSS reported smoking before pregnancy; 23% reported smoking during pregnancy.

Alcohol Use

Prenatal exposure to alcohol is associated with a wide range of infant outcomes, from fetal alcohol syndrome (FAS) to very subtle or no adverse effects. Women who consume more than three ounces of absolute alcohol per day near the time of conception are at highest risk of delivering an infant with FAS (32). Whether lower levels of alcohol consumption and different timing of alcohol use affect the infant is not clear. The critical period of increased risk is near conception

- The year 2000 national health objectives call for an increase by at least 20% in the proportion of pregnant women who abstain from alcohol.

and during the first few weeks after conception, when many women do not know they are pregnant (33). Altered brain development and growth retardation in the fetus have occurred when heavy drinking persists into the third trimester. Although structural malformations associated with drinking in early pregnancy are irreversible, reduced drinking by midpregnancy can modify some delays in growth and development (34).

Only about 68% of records in the 1996 PNSS contained information about alcohol use. As in other data sources (35, 36), underreporting of alcohol use is evident in the PNSS: 15% of women reported drinking during the three months before pregnancy, and 3% reported drinking during pregnancy (all trimesters combined). By contrast, in four states participating in the Pregnancy Risk Assessment Monitoring System in 1988 and 1989, 34% to 58% of women reported drinking during the three months before pregnancy, and 7% to 16% reported drinking during the last three months of pregnancy (35). Because the incomplete information in the PNSS yielded rates of alcohol use much lower than in other data sources, the PNSS data on alcohol use are unreliable and not presented.

Although a national estimate is not available, alcohol consumption by pregnant women is believed to be declining (37).

Birth Outcomes

High Birthweight

High birthweight (>4,000 g) can increase an infant's risk for shoulder dystocia (38). One study suggests that high-birthweight infants are likely to be tall and heavy (39). Several studies have associated high birthweight with subsequent obesity in children and adults; however, none has controlled for maternal prepregnancy weight (40-42).

In the 1996 PNSS, about 9% of infants were high birthweight. The rate ranged from 7% in Utah to about 12% in North Dakota. The rate of high birthweight in the PNSS has changed little since 1989.

□ The rate of high birthweight was nearly 9% in the 1996 PNSS, similar to the rate in 1989.

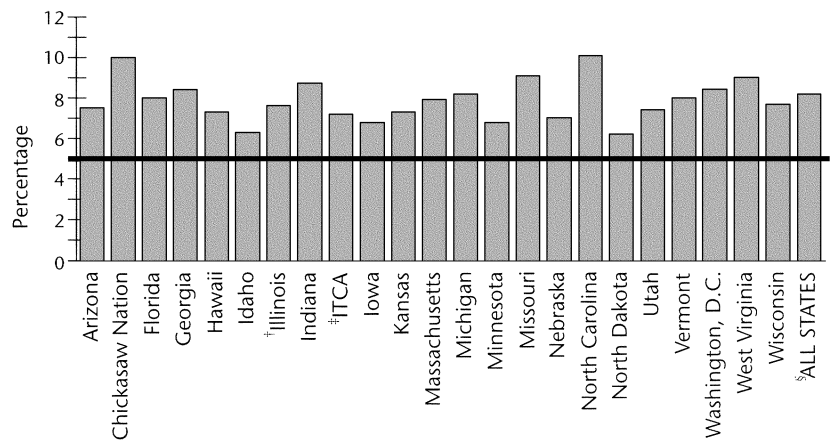
Low Birthweight

Low birthweight (<2,500 g or 5.5 lbs) is the single most important factor affecting neonatal mortality and is a determinant of postneonatal mortality (7). Infants weighing 2,500 g or less are almost 40 times more likely to die during their first four weeks of life than are infants of normal birthweight. Low-birthweight infants who survive are at increased risk for health problems ranging from neurodevelopmental handicaps to lower respiratory tract conditions (43).

Although the infant mortality rate in the United States declined from 26 per 1,000 live births in 1960 to 8 per 1,000 live births in 1994, the nation ranks behind most industrialized countries on this health indicator (44). Low birthweight is a major determinant of infant mortality in the United States (7). Finding effective ways to prevent low birthweight is important to further reducing infant mortality.

In the 1996 PNSS, just over 8% of infants were low birthweight; just over 1% of these infants were also very low birthweight (<1,500 g). The low-birthweight rate ranged from about 6% to 10% (Figure 16). By comparison, more than 7% of all infants

Figure 16.
Incidence* of low birthweight,
by state, 1996 PNSS



*Per 100 live births.

¹Data for this variable were missing from more than 20% of records.

²Inter Tribal Council of Arizona.

³Data not available for Montana.

⁴Reduce low birthweight to an incidence of no more than 5% of all live births.

— Year 2000 objective⁴

born in the United States in 1996 were low birthweight (7). The low-birthweight rate in the PNSS has increased slightly since 1989, when it was just below 8%.

A year 2000 national health objective seeks to reduce the incidence of low birthweight to no more than 5% of all live births and very low birthweight to no more than 1% (8). No state contributing to the 1996 PNSS met the objective for low birthweight, but 14 met it for very low birthweight: Arizona, Florida, Georgia, Idaho, Inter Tribal Council of Arizona, Iowa, Kansas, Michigan, Minnesota, North Dakota, Utah, Vermont, West Virginia, and Wisconsin.

- In the 1996 PNSS, about 8% of infants were low birthweight, and just over 1% of these infants were very low birthweight.
- The year 2000 objectives call for a reduction in low birthweight to no more than 5% of births and very low birthweight to no more than 1% of births.
- The rate of low birthweight in the PNSS has changed little since 1989 when it was nearly 8%.

Risk Factors Associated with Low Birthweight

One way to reduce the incidence of low birthweight is to identify women at risk of bearing low-birthweight infants and provide these women with preventive and therapeutic services. Factors associated with low birthweight include socio-demographic characteristics such as race or ethnicity, age, marital status, and income, as well as nutritional and behavioral factors such as weight gain, smoking, and alcohol consumption (6). The risks for low birthweight are widely distributed throughout the population, and a substantial number of low-birthweight infants will continue to be born to women not considered at high risk. These circumstances highlight the need for improved understanding of risk and causation and should not minimize the value of targeting interventions to women at greatest risk (6).

Demographic factors. The year 2000 target for low birthweight was exceeded in the 1996 PNSS, regardless of demographic group (Figure 17). In the United States, race or ethnicity is an important predictor of low birthweight (6). The proportion of low-birthweight infants born to black women (about 10%) exceeded that of women of other races or ethnicities (5% to 6%). Thus, the risk

for low birthweight was nearly double for black women than for women of other racial or ethnic groups. Why rates are higher for black women is unclear; further research is needed to improve understanding and prevention efforts (6).

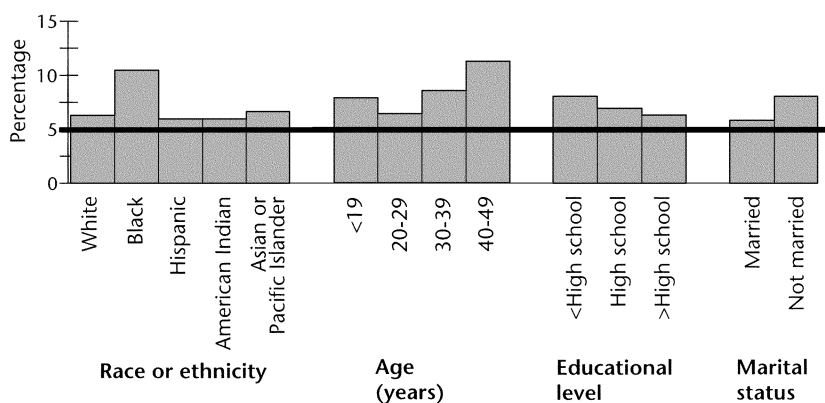
The risk of having a low birthweight infant was high for women aged 19 years or less, similarly high for women aged 30 to 39 years, and even higher for women aged 40 to 49 years (Figure 17).

Studies have shown an independent association between socioeconomic status, education, and low birthweight (6). In the 1996 PNSS, the risk for low birthweight was lowest for mothers having more than a high school education (Figure 17).

Unmarried women are also at a consistently higher risk of delivering a low-birthweight infant than are women who are married. This finding was true for unmarried women in the 1996 PNSS (Figure 17).

□ Women who were black, were aged 19 years or less or aged 30 years or more, had less than a high school education, or were unmarried in the 1996 PNSS were at higher risk of delivering a low-birthweight infant than were their counterparts.

Figure 17.
Incidence* of low birthweight,
by sociodemographic variables, 1996 PNSS



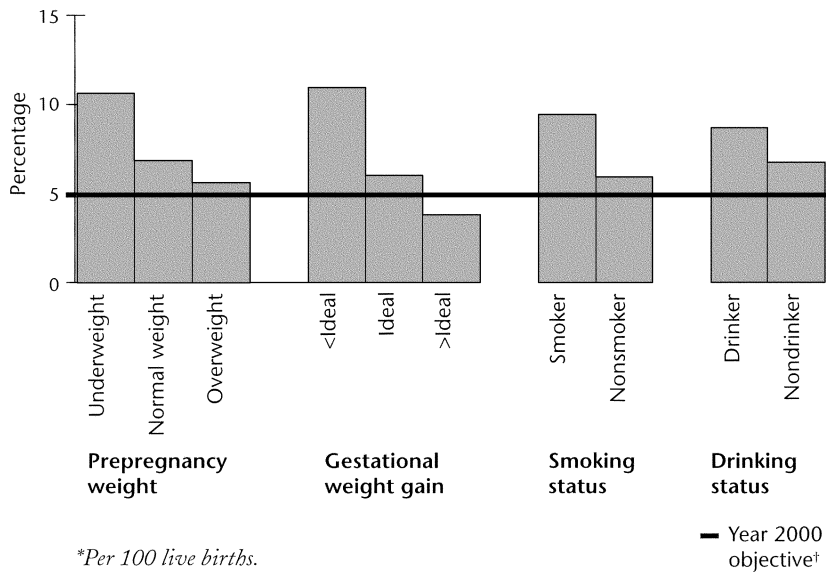
*Per 100 live births.

†Reduce low birthweight to an incidence of no more than 5% of all live births.

— Year 2000 objective†

Nutritional and behavioral factors. Risk factors for delivering a low-birthweight infant include prepregnancy underweight and gaining less weight than recommended during pregnancy (6, 45). In the 1996 PNSS, the risk of delivering a low-birthweight infant was nearly double for both underweight women and women who did not gain adequate weight during pregnancy, when compared with their counterparts (Figure 18).

Figure 18.
Incidence* of low birthweight,
by maternal risk factors, 1996 PNSS



*Per 100 live births.

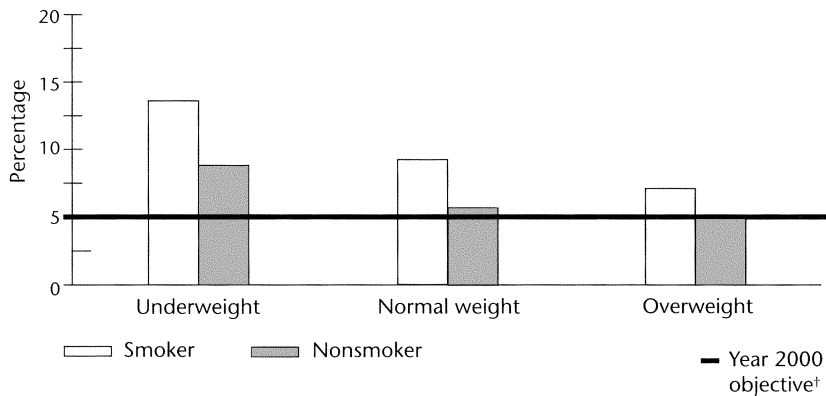
†Reduce low birthweight to an incidence of no more than 5% of all live births.

— Year 2000 objective†

Babies born to women who smoke during pregnancy weigh, on average, 200 g less than babies born to comparable women who do not smoke (46). In the PNSS, the incidence of low birthweight was increased among infants born to women who smoked during pregnancy (Figure 18). Although the quality of data on alcohol consumption during pregnancy was poor, this behavior was also associated with low birthweight (Figure 18).

Women who have multiple risk factors are of greatest concern. For example, the incidence of delivering a low-birthweight infant was much higher for underweight women who smoked (14%) than for normal weight women who did not smoke (6%) (Figure 19).

Figure 19.
Incidence* of low birthweight, by prepregnancy weight and smoking status, 1996 PNSS



*Per 100 live births.

†Reduce low birthweight to an incidence of no more than 5% of all live births.

— Year 2000 objective†

- In the 1996 PNSS, underweight women and women who gained less weight than recommended during pregnancy had nearly double the risk of delivering a low-birthweight infant.
- Women who reported smoking or drinking during pregnancy were at increased risk of delivering a low-birthweight infant.
- Women who have multiple nutritional and behavioral risk factors are at highest risk of having a low-birthweight infant.

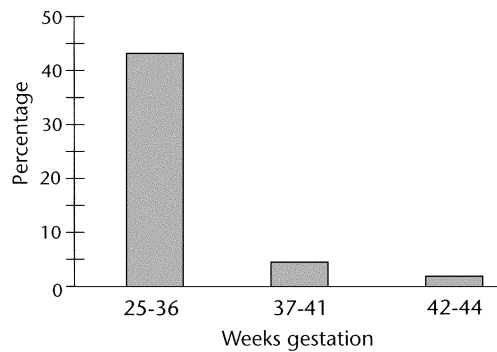
Prematurity

Nutritional problems of premature infants include immature sucking and swallowing, digestion and absorption, necrotizing enterocolitis, and small gastric capacity (43). In the 1996 PNSS, close to 9% of infants were born preterm (prior to 37 weeks gestation). These infants were 10 times more likely to be low birthweight than were infants born at term (Figure 20). Preterm, low-birthweight infants are two to three times more likely to die in the first year of life than are full-term, low-birthweight infants (47).

The rate of premature births for the Chickasaw Nation was less than half that for North Carolina and Washington, D.C. (Figure 21).

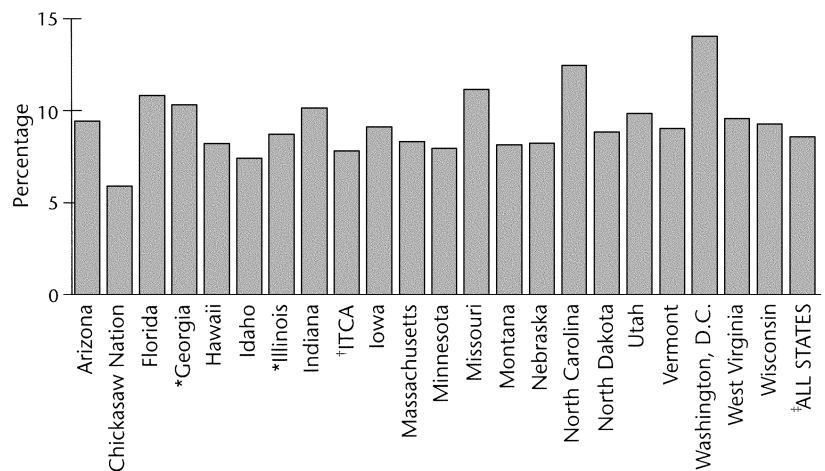
- Almost 9% of infants born to women in the 1996 PNSS were premature (<37 weeks gestation).
- In the 1996 PNSS, premature infants were more than 10 times as likely to be low birthweight than were infants born at term.

Figure 20.
Incidence* of low birthweight,
by gestational age, 1996 PNSS



*Per 100 live births.

Figure 21.
Incidence of infant prematurity,
by state, 1996 PNSS



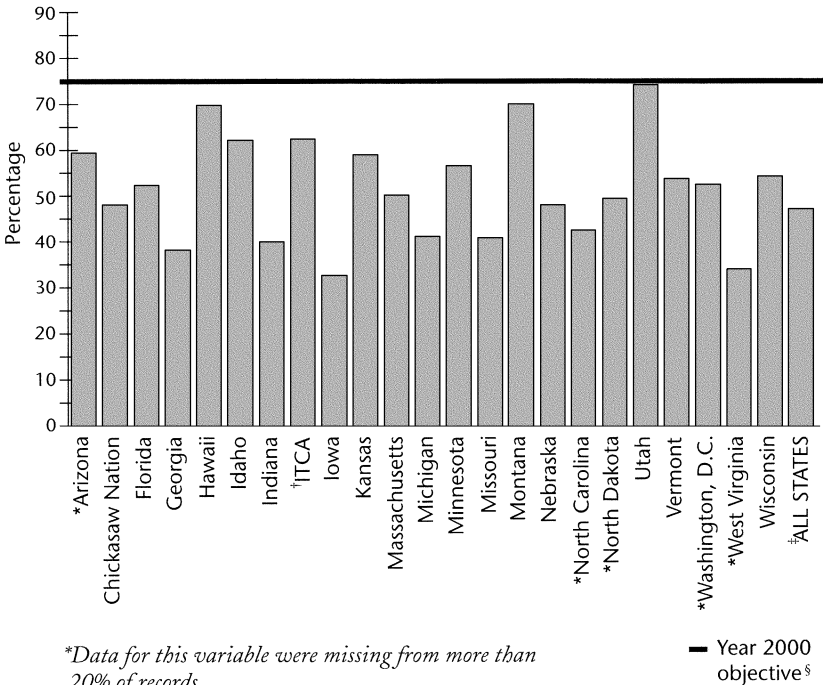
*Data for this variable were missing from more than 20% of records.

[†]Inter Tribal Council of Arizona.

[‡]Data not available for Kansas and Michigan.

Infant-Feeding Practices

Figure 22.
Percentage of infants ever breastfed,
by state, 1996 PNSS



*Data for this variable were missing from more than 20% of records.

†Inter Tribal Council of Arizona.

‡Data not available for Illinois.

§Increase to at least 75% the porportion of mothers who breastfeed their babies in the early postpartum period.

Breastfeeding

The nutritional, immunologic, hypo-allergenic, economic, and psychological advantages of breastfeeding are well recognized. Breast milk is nutritionally superior to any alternative milk supply; provides immunity to many viral and bacterial diseases; enhances infants’ immunologic defenses; prevents or reduces risk for respiratory and diarrheal diseases; promotes correct development of jaws, teeth, and speech patterns; decreases tendency toward childhood obesity; and facilitates maternal-infant attachment (48).

About 47% of infants born to women in the 1996 PNSS were ever breastfed. The percentage varied greatly from state to state: 32% to 34% in Iowa and West Virginia and 70% to 74% in Hawaii, Montana, and Utah (Figure 22). Mothers who were black, white, or Asian or Pacific Islander were less likely to breastfeed than were Hispanic or American Indian mothers. The incidence of breastfeeding increased with age and educational level (Figure 23).

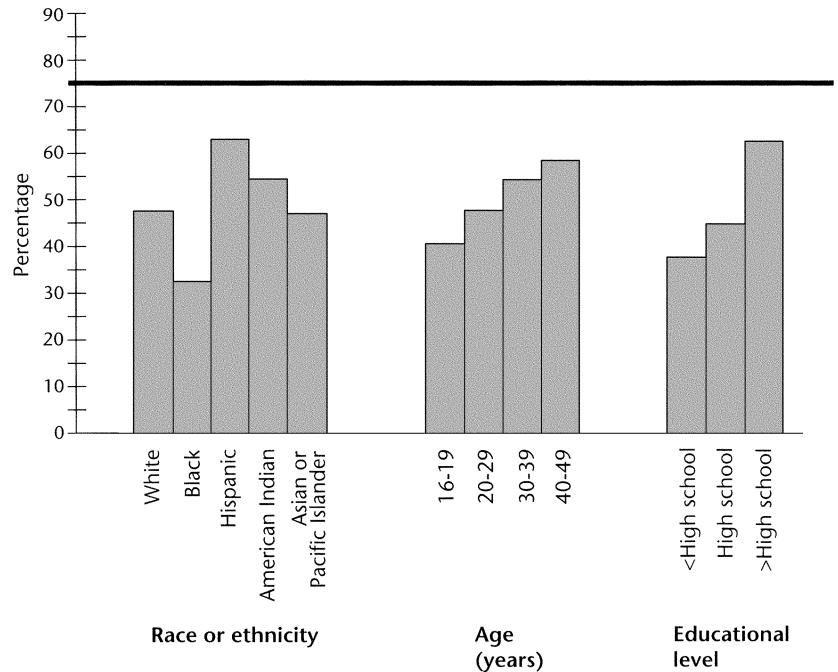
The year 2000 national health objective for breastfeeding is to increase to at least 75% the proportion of mothers who breastfeed

their babies in the early postpartum period (8). This objective was not achieved in the PNSS population in any state.

The prevalence of breastfeeding among mothers in the PNSS has changed little since 1989. This stability, however, represents a halt to the decline in breastfeeding rates that occurred among low-income women in the middle to late 1980s (49). Other data sources indicate that the rate for all U.S. women has increased somewhat—from 52% in 1989 to 60% in 1995 (50).

- The percentage of mothers in the PNSS who ever breastfed their infants has changed little over the past seven years.
- Only 47% of infants born to women in the 1996 PNSS were ever breastfed.
- The year 2000 health objective calls for an increase to at least 75% in the proportion of mothers who breastfeed their babies in the early postpartum period.

Figure 23.
Incidence of breastfeeding,
by sociodemographic variables, 1996 PNSS



*Increase to at least 75% the proportion of mothers who breastfeed their babies in the early postpartum period.

— Year 2000 objective*

Conclusions and Recommendations

The 1996 PNSS data demonstrate that progress has occurred in several areas of maternal and child health among low-income women and their infants. The year 2000 national health objective for the incidence of very low birthweight (no more than 1%) has nearly been achieved in the PNSS population. The number of pregnant women enrolled in the WIC program increased, as did the proportion of women who enrolled in the program during their first trimester of pregnancy. Although breastfeeding rates have not increased, they have not continued to decline as they did among low-income women in the middle to late 1980s.

National health objectives pertaining to teenage pregnancy, prepregnancy overweight among women aged 20 years or older, achievement of minimum recommended weight gain during pregnancy, anemia among black women in the third trimester of pregnancy, smoking cessation during pregnancy, incidence of low birthweight, and prevalence of breastfeeding were not achieved in the PNSS population. Anemia among women in the PNSS also did not decline.

National and State Nutritional and Behavioral Risk Factor Reduction

The PNSS data indicate that national and state public health programs are needed to support the following nutritional and behavioral interventions.

Nutritional Interventions

1. Provision of preconception nutrition care, integrated into primary care, to address prepregnancy nutritional risks such as underweight, obesity, and anemia.
2. Outreach activities promoting early identification of pregnancy and early entry into comprehensive prenatal care, including WIC program services.
3. Encouragement of recommended pregnancy weight gain, based on prepregnancy weight status, particularly for underweight women and teenagers.
4. Promotion of adequate dietary iron intake and iron supplementation

-
- during pregnancy, and screening to identify women at risk for iron deficiency.
5. Establishment of breastfeeding as a societal norm. Continued development and implementation of effective strategies to promote breastfeeding.
 6. Implementation of innovative strategies to reverse the rising trend of overweight among women, including the prevention of overweight before reproductive age and the reduction of postpartum weight retention among overweight women.

Behavioral Interventions

1. Continued efforts to improve the effectiveness of teenage pregnancy prevention initiatives.
2. Provision of smoking cessation services for all pregnant women, especially those who are underweight.
3. Encouragement of abstinence from alcoholic beverages during pregnancy. Access to alcohol rehabilitation services for all women who need them.

Nutrition Services and Research

Improvement of the nutrition-related behaviors and outcomes for pregnant women and infants will not be achieved through clinical interventions alone. The following service and research components are needed.

1. Broad-based public health initiatives comprising mass media campaigns,

environmental changes, service delivery improvements, and social support networks.

2. Intervention research to determine which strategies are successful in reducing risk and achieving the nutritional and behavioral interventions described above.

National and State Nutrition Monitoring

The following actions will further enhance the representativeness and integrity of the PNSS.

1. Expansion of state, U.S. territory, tribal government, and managed care participation in the PNSS.
2. Provision of CDC technical assistance to participating agencies to support

system initiation and maintenance as well as resolve data quality problems.

3. Efforts by contributors to improve their data quality so that complete and accurate information is available for program planning, evaluation of interventions, and grant development.

References

1. CDC: Enhanced Pregnancy Nutrition Surveillance System user's manual. Atlanta: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Division of Nutrition and Physical Activity, Maternal and Child Health Branch, 1994.
2. Kim I, Hungerford DW, Yip R, et al: Pregnancy Nutrition Surveillance System—United States, 1979-1990. *MMWR* 1992;41(SS-7):25-41.
3. Perry G, Yip R, Zyrkowski C: Nutritional risk factors among low-income pregnant women: the Centers for Disease Control and Prevention Pregnancy Nutrition Surveillance System, 1979 through 1993. *Semin Perinatol* 1995;19:211-221.
4. CDC: 1995 annual Pregnancy Nutrition Surveillance System narrative report. Atlanta: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Division of Nutrition and Physical Activity, Maternal and Child Health Branch, 1996.
5. U.S. Department of Agriculture, Food and Nutrition Service: Special Supplemental Nutrition Program For Women, Infants, and Children (WIC) eligibility and coverage estimates, 1996 update—U.S. and outlying areas. Alexandria, VA: U.S. Department of Agriculture, 1998.
6. National Academy of Sciences: Preventing low birthweight: report of the Committee to Study the Prevention of Low Birthweight. Washington, DC: National Academy of Sciences, 1985.
7. Ventura SJ, Kimberly MA, Martin JA, et al: Births and deaths: United States, 1996; preliminary data. *Monthly vital statistics report*; vol 46(1), supp. 2. Hyattsville, MD: National Center for Health Statistics, 1998.
8. Public Health Service: Healthy people 2000: National health promotion and disease prevention objectives—full report, with commentary. Washington, DC: U.S. Department of Health and Human Services, 1991; DHHS publication no. (PHS) 91-50212.
9. Ventura SJ, Martin JA, Matthews TJ: Report of final natality statistics, 1995. *Monthly vital statistics report*; vol 45(11), supp. 2. Hyattsville, MD: National Center for Health Statistics, 1997.
10. Brown SS, ed., Committee to Study Outreach for Prenatal Care: Prenatal care: reaching mothers, reaching infants. Washington, DC: National Academy Press, 1988.
11. Rush D: The national WIC evaluation: evaluation of the Special Supplemental Food Program for Women, Infants, and Children. *Am J Clin Nutr* 1988;48:389-519.
12. General Accounting Office: Early intervention: federal investments like WIC can produce savings. Washington, DC: General Accounting Office, 1992.
13. Abrams BF, Laros RK: Prepregnancy weight, weight gain and birthweight. *Am J Obstet Gynecol* 1986;154:503-509.
14. Perlow JH, Morgan MA, Montgomery D, Towers D, Porto M: Perinatal outcome in pregnancy complicated by massive obesity. *Am J Obstet Gynecol* 1992;167:958-962.

15. Institute of Medicine: Nutrition during pregnancy: weight gain and nutrient supplementation. Washington, DC: National Academy Press, 1990.
16. Galuska D, Serdula M, Pamuk E, Siegel PZ, Byers T: Trends in overweight among U.S. adults from 1987 to 1993: a multi-state telephone survey. *Am J Public Health* 1996;86:1729-1735.
17. Kuczmarski RJ, Flugal KM, Campbell SM, Johnson CL: Increasing prevalence of overweight among U.S. adults: the National Health and Nutrition Examination Surveys 1960 to 1991. *JAMA* 1994;272:205-211.
18. Stevens-Simon C, McAnarney ER, Coulter MP: How accurately do pregnant adolescents estimate their weight prior to pregnancy? *J Adolesc Health Care* 1986;7:250-254.
19. Perry GS, Byers TE, Mokdah AH, et al: The validity of self-reports of past body weight by U.S. adults. *Epidemiology* 1995;6:61-66.
20. Institute of Medicine: Iron deficiency anemia: revised guidelines for prevention, detection and management among U.S. children and women of childbearing age. Washington, DC: National Academy Press, 1993.
21. Scholl TO, Hediger ML, Eischer RL, Shear JW: Anemia vs. iron deficiency: increased risk of preterm delivery in a prospective study. *Am J Clin Nutr* 1992;55:985-988.
22. Yip R, Parvanta I, Cogswell M, et al: Recommendations to prevent and control iron deficiency in the United States. *MMWR* 1998;47(RR-3):1-29.
23. Looker A, Dallman PR, Carroll MD, Gunter EW, Johnson CL: Prevalence of iron deficiency in the United States. *JAMA* 1997;277:973-976.
24. Kleinman JC, Pierre MB, Madans JH, et al: The effects of maternal smoking on fetal and infant mortality. *Am J Epidemiol* 1988;127:274-282.
25. Cogswell ME, Yip R: The influence of fetal and maternal factors on the distribution of birthweight. *Semin Perinatol* 1995;19:222-240.
26. Haglund B, Cnattingius S: Cigarette smoking as a risk factor for sudden infant death syndrome: a population-based study. *Am J Public Health* 1990;80:29-32.
27. Armstrong BG, McDonald AD, Sloan M: Cigarette, alcohol and coffee consumption and spontaneous abortion. *Am J Public Health* 1992;82:85-87.
28. Wen SW, Goldenberg RL, Cutter GR, et al: Smoking, maternal age, fetal growth and gestational age. *Am J Obstet Gynecol* 1990;162:53-58.
29. Martin TR, Bracken MB: Association of low birth weight with passive smoke exposure in pregnancy. *Am J Epidemiol* 1986;124:633-642.
30. Peacock JL, Bland JM, Anderson HR, et al: Cigarette smoking and birthweight: type of cigarette smoked and a possible threshold effect. *Int J Epidemiol* 1991;20:405-412.
31. CDC: Cigarette smoking among adults—United States, 1995. *MMWR* 1997;46(51):1217-1219.
32. Halmesmaki E, Raivio K, Ylikorkala O: Patterns of alcohol consumption during pregnancy. *Obstet Gynecol* 1987;69:594-597.
33. Petrakis P: Alcohol and birth defects: the fetal alcohol syndrome and related disorders. Rockville, MD: U.S. Department of Health and Human Services, Public Health Service, National Institute on Alcohol Abuse and Alcoholism, 1987; DHHS publication no. (ADM) 87-1531.
34. Rosett H, Weiner L, Lee A, et al: Patterns of alcohol consumption and fetal development. *Obstet Gynecol* 1983;61:539-546.

-
35. Bruce FC, Adams MM, Shulman HB, et al: Alcohol use before and during pregnancy. *Am J Prev Med* 1993;9:267-273.
 36. Emhart C, Morrow T, Sokol R, Martier S: Underreporting of alcohol use in pregnancy. *Alcoholism* 1988;12:506-511.
 37. Serdula M, Williamson DF, Kendrick JS, et al: Trends in alcohol consumption by pregnant women, 1985 through 1988. *JAMA* 1991;265:876-879.
 38. Acker DB, Sachs BP, Friedman EA: Risk factors for shoulder dystocia. *Obstet Gynecol* 1985;66:762-768.
 39. Binkin NJ, Yip R, Fleshood L, Trowbridge FL: Birthweight and childhood growth. *Pediatrics* 1985;82:762-768.
 40. Lehingue Y, Miginiac M, Locard E, et al: Birth weight and obesity at the age of 6. Study from the growth curves of a population of schoolchildren [in French]. *Pediatric* 1993;48:623-632.
 41. Curhan GC, Willet WC, Rimm EB, et al: Birth weight and adult hypertension, diabetes mellitus, and obesity in U.S. men. *Circulation* 1996;94:3246-3250.
 42. Curhan GC, Chertow GM, Willet WC, et al: Birth weight and adult hypertension and obesity in women. *Circulation* 1996;94:1310-1315.
 43. Paneth KA: The problem of low birthweight. *Future Child* 1995;5:19-34.
 44. Bellamy C: The state of the world's children. New York: Oxford University Press for United Nations International Children's Emergency Fund, 1997.
 45. Taffel S: Maternal weight gain and the outcome of pregnancy, United States, 1980. *Vital and health statistics, series 21, no. 44*. Washington, DC: U.S. Department of Health and Human Services, 1986; DHHS publication no. (PHS) 86-1922.
 46. U.S. Department of Health and Human Services: The health consequences of smoking for women: a report of the Surgeon General. Rockville, MD: U.S. Department of Health and Human Services, Public Health Service, Office on Smoking and Health, 1980.
 47. Sappenfeld WM, Buehler JW, Binkin NJ, et al: Differences in neonatal and postneonatal mortality by race, birthweight, and gestational age. *Public Health Rep* 1987;102:182-191.
 48. Jacobi AM, Levin M: Promotion and support of breastfeeding. In: Worthington-Roberts B, Rodwell Williams S, eds. *Nutrition in pregnancy and lactation*. 5th ed. St. Louis, MO: Mosby, 1993:402-461.
 49. CDC: Pediatric Nutrition Surveillance System annual reports, Atlanta: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Division of Nutrition and Physical Activity, Maternal and Child Health Branch, 1980-1995.
 50. Ryan AS: The resurgence of breastfeeding in the United States. *Pediatrics* 1997;99:596[abstract]. URL:<http://www.pediatrics.org/cgi/content/full/99/4/e12>