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Pediatric Nutrition Surveillance System — United States, 1980–1991

Pregnancy Nutrition Surveillance System — United States, 1979–1990

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Abbreviations

NCCDPHP	National Center for Chronic Disease Prevention and Health Promotion
NCEHIC	National Center for Environmental Health and Injury Control
NCID	National Center for Infectious Diseases
CIO	Centers/Institute/Offices
IHPO	International Health Program Office
NCPS	National Center for Prevention Services
EPO	Epidemiology Program Office
NIOSH	National Institute for Occupational Safety and Health

Pediatric Nutrition Surveillance System—United States, 1980–1991

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Summary

The CDC Pediatric Nutrition Surveillance System (PedNSS) monitors the general health and nutritional characteristics of low-income U.S. children who participate in multiple public health programs. This system is intended to characterize trends and patterns in key indicators of nutritional status so that the information can be used for program planning and targeting. The indicators monitored by PedNSS are birth weight, childhood growth status, anemia, and breast-feeding patterns. From 1980 through 1991, the trends for low birth weight, low height-for-age (shortness), low weight-for-height (thinness), and high weight-for-height (overweight) were stable for all children monitored by the PedNSS, with the exception of Asian children, who were predominantly of Southeast Asian refugee background. In the early 1980s, the prevalence of low birth weight and shortness was higher among Asian children than among children of other racial or ethnic groups who were monitored by the PedNSS. However, these prevalences declined steadily from 1980 through 1991. By 1991, the prevalences of low birth weight and shortness for Asian children were similar to those observed for children of other races/ethnic groups. Overall, low-income U.S. children had a slightly lower height-for-age than expected, indicating that some of these children were at a health and nutritional disadvantage. The prevalence of overweight varied among different racial/ethnic groups; Hispanic and Native American children had the highest prevalences of overweight. The 20%–30% prevalence of anemia among low-income children monitored by the PedNSS was higher than among the general population, reflecting in part the preferential enrollment and retention of anemic children by public health nutrition programs and also indicating that many children had inadequate iron nutrition. From 1980 through 1991, the prevalence of anemia declined >5% for most of the age- and race/ethnicity-specific groups monitored by PedNSS. That decline represents an improvement in iron nutritional status. PedNSS is a useful system for the monitoring and characterization of the nutrition status of low-income children at both state and national levels.

INTRODUCTION

In the late 1960s, the United States Ten-State Nutrition Survey characterized the nutritional status of children from low-income families as being less than satisfactory

(*1*). These findings generated concern about the nutritional status of low-income populations in the United States. In response, in 1973 CDC began working with five states (Arizona, Kentucky, Louisiana, Tennessee, and Washington) to develop a system for continuously monitoring the nutritional status of specific high-risk population groups (*2*). By 1991, this Pediatric Nutrition Surveillance System (PedNSS) had expanded to include public health and nutrition programs from 41 states, the District of Columbia, Puerto Rico, the Intertribal Council of Arizona, and the Navajo Nation.

PedNSS is designed to monitor the nutritional status of low-income children enrolled in clinics served by publicly funded health and nutrition programs. Nutritional status is assessed by growth and hematologic measurements. The PedNSS provides data on the prevalence of nutrition-related indicators and their trends among specific groups of children. Health professionals use such information to improve clinical care, manage resources, and plan and evaluate programs.

The PedNSS provides a framework for analyzing and tabulating state-specific surveillance data. Participating state and territorial health departments and Native American agencies collect the standardized data items and submit the information monthly to CDC. After analyzing these data, CDC returns clinic-specific reports to the participating health departments each month. Summary reports by clinic, county, and state are generated semiannually and annually. Computer software has been provided to 22 states, the Intertribal Council of Arizona, and the Navajo Nation to enable them to generate surveillance reports locally. This report details the trends and characteristics of the nutritional status of the infants and children monitored by the PedNSS during the period 1980–1991.

METHODS

Data Sources and Characteristics of Participants

Data Collection

PedNSS collects specific data from the clinic record of each child from each visit to a participating program. This individual demographic and health screening information is collected with state- and program-specific coding forms, processed at the state level, and forwarded to CDC for analysis. For each child's visit to a participating clinic, a surveillance record is generated. Therefore, a child with multiple visits to a clinic at different ages will have multiple records on the surveillance system. On average, each child contributes 2.1 records to the PedNSS.

Data Items

These types of surveillance data are collected:

a. Demographic: clinic, county, date of birth, date of visit, race/ethnic group, sex, type of program, and type of visit (initial visit vs. follow-up visit)
b. Anthropometric: birth weight, height, and weight
c. Hematologic: hemoglobin, hematocrit, and erythrocyte protoporphyrin
d. Method of feeding: whether a child has ever been breast-fed and whether the child is currently breast-fed.

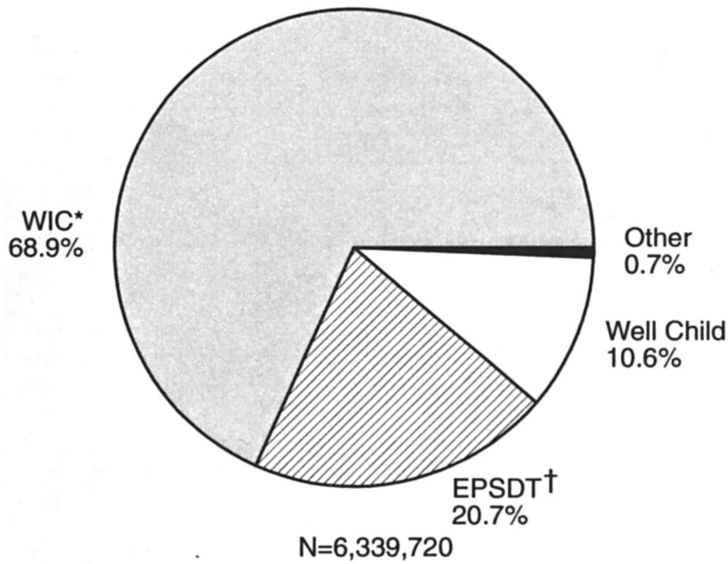
Participating Programs

PedNSS uses readily available data from selected public health and nutrition programs such as the Special Supplemental Food Program for Women, Infants, and Children (WIC); Head Start; Early and Periodic Screening, Diagnosis, and Treatment (EPSDT) Program; and other programs that are funded by Maternal and Child Health (MCH) block grants. The program composition in each participating state varied, but in 39 states WIC was the only program contributing data to the PedNSS. Program composition for PedNSS in 1991 showed that the majority of the 1991 records came from the WIC program (Figure 1); however, a large proportion of the records provided by EPSDT, Well Child, and other MCH programs represented children who were also served by the WIC program. Persons eligible for the WIC program are of low-income status—approximately <170% of the poverty index based on household income (poverty level is defined as 100% of the poverty index)—and are at risk for poor nutritional outcomes. Because the majority of the PedNSS records are from WIC and other programs with income eligibility requirements, PedNSS is in essence a surveillance system specific for children from low-income families.

Participating states

PedNSS expanded from the initial five states in 1973 to 41 states in 1991. However, the pattern of participation has fluctuated throughout the years (Figure 2). As the num-

FIGURE 1. Program composition — Pediatric Nutrition Surveillance System, United States, 1991



*Special Supplemental Food Program for Women, Infants, and Children
†Early and Periodic Screening, Diagnosis, and Treatment Program

FIGURE 2. States* submitting records, 1975–1991[†] — Pediatric Nutrition Surveillance System

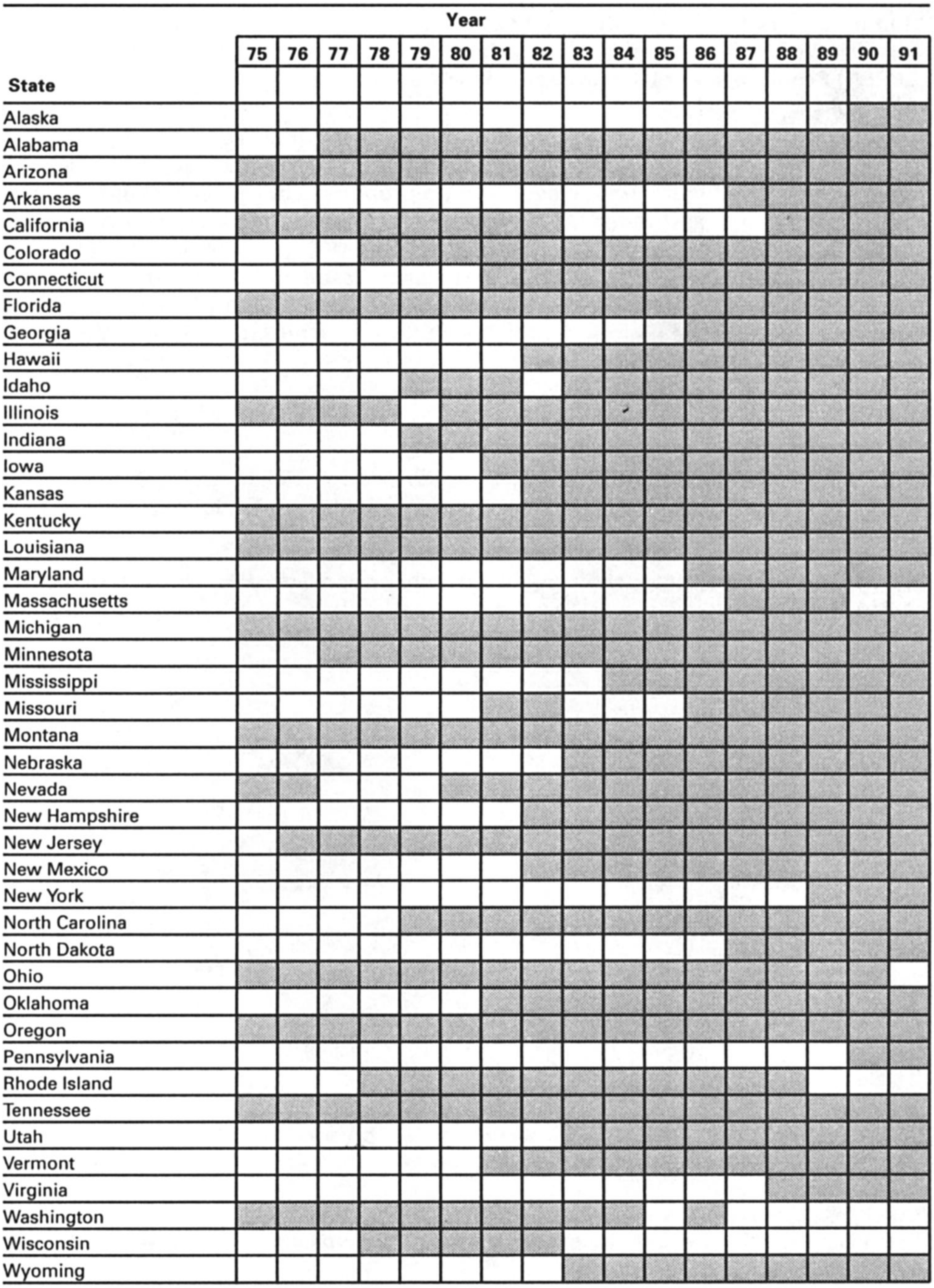


FIGURE 2. States submitting records, 1975–1991* — Pediatric Nutrition Surveillance System — Continued

State	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91
District of Columbia							■	■	■	■	■	■	■	■	■	■	■
Puerto Rico										■	■	■	■	■	■	■	■
Intertribal Council of Arizona													■	■	■	■	
Navajo Nation								■	■	■	■	■	■	■	■	■	

* Includes the District of Columbia, Puerto Rico, the Intertribal Council of Arizona and the Navajo Nation.
† Shading indicates years in which records were submitted.

ber of states in the PedNSS has increased, so has the number of records received by CDC (Figure 3). In 1991, 6,339,720 records were received from 5,140 clinics.

Age composition

With the exception of EPSDT programs, which enroll children up to 18 years of age, WIC and other maternal and child health programs enroll only children <5 years of age. For this reason, 93% of the surveillance records for 1991 were from children <5 years of age; 40% were from children <1 year of age (Figure 4). The rapid decline in the number of records for children as their ages increase is because the WIC program gives priority to infants and younger children for enrollment and retention. Only older children with health and nutritional risk factors are retained. Because of this differential retention practice, the health and nutritional status of children cannot be compared fairly across all ages.

Racial and Ethnic Group Composition

In 1991, minority children constituted nearly 60% of all children enrolled (Figure 4). The racial composition of the surveillance system was stable during the first half of the 1980s (Figure 5). The proportion of records for Hispanic children increased in 1984 when Puerto Rico began participating in PedNSS, with a corresponding decrease in the proportion of records for white children. Another substantial increase in the number and proportion of records for Hispanic children occurred in 1988 and 1989, when California and New York, states with a substantial number of records and a high proportion of records from Hispanic children, joined the PedNSS (Figure 5). From 1975 through 1980, the proportion of Asian children increased considerably because of the influx of Southeast Asian refugees to the United States (data not shown).

Nutrition Indicators and Criteria

Birth Weight

Birth weight was reported by parents. For the PedNSS, low birth weight (LBW) is defined as birth weight <2,500 g. A previous study comparing birth weights reported by parents in the PedNSS with those recorded on birth certificates found close agreement, without significant misclassification of LBW (*3*). Birth weight reflects maternal

FIGURE 3. Number of records submitted per year — Pediatric Nutrition Surveillance System, United States, 1980–1991

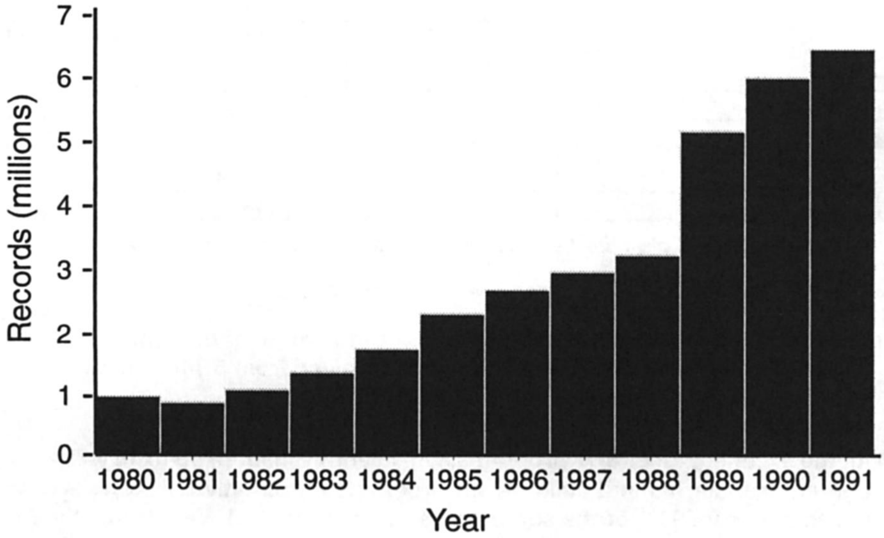
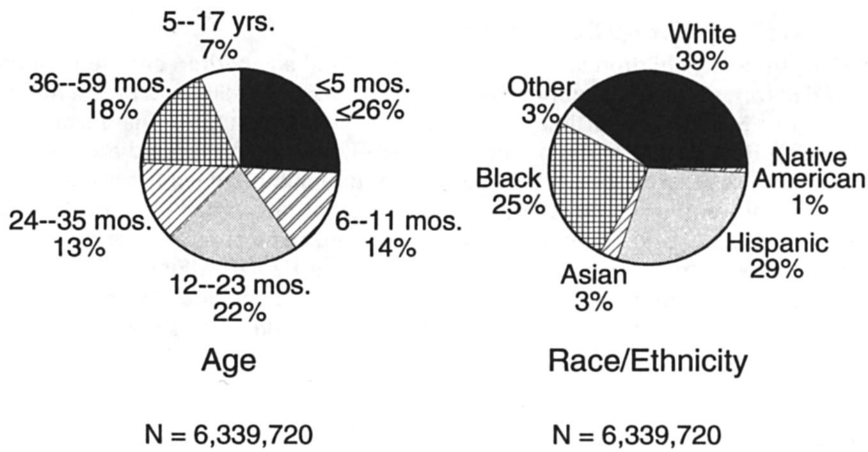


FIGURE 4. Age and racial/ethnic distribution — Pediatric Nutrition Surveillance System, United States, 1991



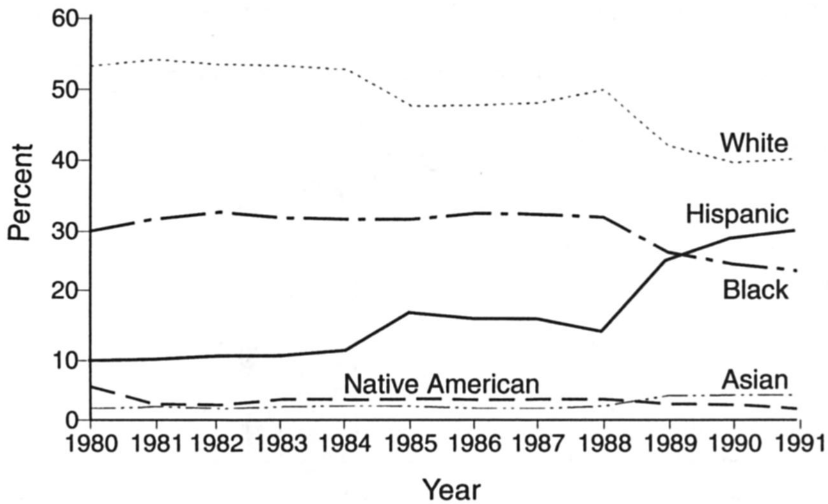
health status during pregnancy and is a strong predictor of later childhood growth (*4*). Mean birth weight and LBW rate correlate with the socioeconomic status (SES) of the population and can reflect the trend and composition of SES among PedNSS participants (*5*).

General Nutritional Status

Growth Measurements and Indices

Public health and nutrition clinics measure height (or length) and weight as part of a clinic-based growth monitoring program to screen children with greater likelihood for health and nutrition disorders for further evaluation or follow-up. In general, length is measured for children <24 months of age and is based on recumbent measurement. Height, which is measured for children ≥24 months, is based on standing measurement. For the PedNSS, the measured height and weight are interpreted by the computer software version of the National Center for Health Statistics (NCHS)-CDC growth reference as three growth indices: height-for-age, weight-for-height, and weight-for-age (*6*).

FIGURE 5. Proportion of records submitted, by racial/ethnic group — Pediatric Nutrition Surveillance System, United States, 1980–1991



Expression and Cutoff Criteria of Growth Indices

Growth indices can be expressed in the traditional percentile values or the more useful form of standard deviation values or Z-scores (*7*). The Z-score of each growth index for each child was calculated by the following formula:

$$Z = \frac{\text{(observed value) - (reference mean value)}}{\text{(reference standard deviation value)}}$$

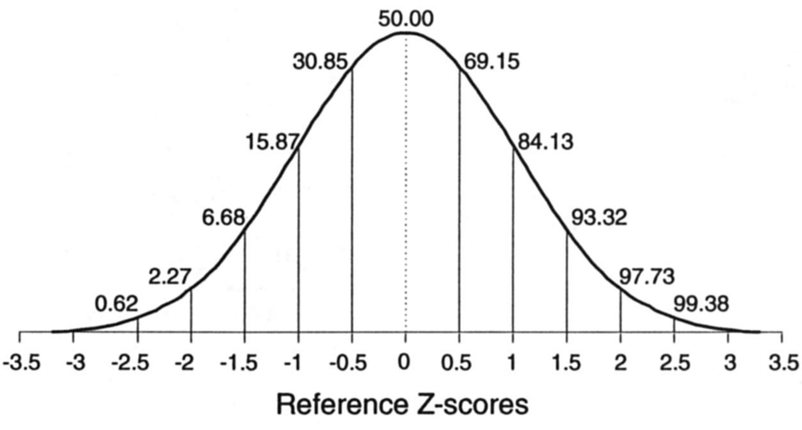
For example, the height-for-age Z-score for a 36-month-old boy whose height is 89.5 cm has a Z-score of -1.19. This score was calculated on the basis of a reference mean height of 93.9 cm and a standard deviation value of 3.7 cm for boys at 36 months of age, according to the NCHS-CDC growth reference:

$$Z = \frac{(89.5)-(93.9)}{(3.7)} = -1.19$$

There was a corresponding relationship between the percentile scale and the Z-score scale (Figure 6). For example, the -1.19 height-for-age Z-score is equivalent to the 12th percentile. The median or 50th percentile is equivalent to a Z-score of 0.0.

For determining the prevalence of abnormal growth indices, both the percentile-based cutoff and the Z-score-based cutoff can serve the same purpose. For example, the World Health Organization (WHO)-recommended cutoff for low height-for-age of a Z-score of ≤2.0 is equivalent to less than percentile 2.3 (*8*). For the PedNSS, the cutoff level of abnormal indices is below the 5th percentile or above the 95th percentile, cor-

FIGURE 6. Z-score and corresponding percentile values of a normal distribution curve



responding to a Z-score of ≤1.65 and ≥1.65. The reason that more generous cutoffs were applied for PedNSS is because the public health programs involved in PedNSS use growth indices for screening and evaluation, and the more generous cutoffs enable program personnel to identify children with borderline growth status (*2*). Because the defined cutoffs for the reference were the 5th and 95th percentiles, the expected baseline level of prevalence was 5% for either an abnormally low or high growth index. A prevalence above the baseline level of 5% would be cause for concern.

For surveillance, applying the Z-score-based growth indices to characterize a population's nutritional status beyond prevalence information has an advantage. Because the Z-score scale is linear, summary statistics such as means, standard deviations, and standard errors can be computed from Z-score values. The Z-score-based summary statistics are also helpful for grouping growth data by age and sex. The summary statistics can be compared with the reference, which has an expected mean Z-score of 0 and a standard deviation of 1.0 for all three growth indices. Because the percentile scale is not linear, it cannot be further computed as summary statistics.

The Importance of Growth Indicators

Height-for-Age. Low height-for-age was defined as a height-for-age value below the 5th percentile or the -1.65 Z-score of the NCHS-CDC height reference. Low height-for-age, also referred to as shortness or stunting, reflects the long-term health and nutritional history of a child or a population. On an individual level, shortness can reflect the normal variation of growth within a population. The shorter stature of some children is related to factors such as lower birth weight or short parental stature. Short stature can also be the result of growth stunting, which is a consequence of poor nutrition, increased frequency of infections, or both. On a population level, an increased prevalence of stunting reflects poor socioeconomic conditions (*9*). On the basis of the WHO-recommended cutoff of a Z-score of -2.0 or 2.3rd percentile for low height-for-age, the worldwide variation in stunting ranges from 2% to 5% in developed nations and as high as 60%–70% in some developing countries (*9*).

For children <24 months of age, the NCHS-CDC reference curves were based on a sample of children from Yellow Springs, Ohio, who were measured by investigators at the Fels Research Institute. These children happened to be taller than average U.S. children and hence contribute to an observed negative Z-score for children 1–2 years of age (*10,11*). For children ≥2 years of age, the NCHS-CDC growth reference curves were based on a representative sample of U.S. children. The difference in height characteristics between the Fels sample and the U.S. sample causes an abrupt change in prevalence of low height-for-age and mean Z-score when children reach 24 months of age. As a result, based on the PedNSS cutoff of less than the 5th percentile, the expected rate of low height-for-age for children >2 years of age is 5%. For children <2 years of age, the expected rate of low height-for-age is higher because the growth reference for this age group was based on the Fels sample of taller-than-average children (*10*).

Weight-for-Height. Low weight-for-height (<5th percentile), or thinness, is often associated with recent severe disease. In developing countries, thinness indicates acute malnutrition, which is mainly the result of starvation, persistent diarrhea, or both. Unlike low height-for-age, which has great worldwide variation associated with economic status, the prevalence of low weight-for-height is usually <5% except during disaster conditions, such as famine and war, that result in severe food shortages and disease outbreaks. For this reason, a prevalence of low weight-for-height greater than 5% reflects serious health and nutrition problems.

High weight-for-height or overweight (weight-for-height >95th percentile), an indicator that correlates well with obesity, is related to an imbalance of energy intake and energy expenditure, often associated with excess food consumption, inadequate physical activity, or both. Overweight in childhood increases the risk of overweight and cardiovascular disease in adulthood.

Weight-for-Age. Weight-for-age is a composite index of height-for-age and weight-for-height. In the case of low weight-for-age, a child could be either small, with proportionally low height and low weight, or too thin (low weight-for-height). Consequently, on a cross-sectional basis, weight-for-age is less useful than height-for-age or weight-for-height in defining nutritional status. Fortunately, in most populations in which there are few or no children with low weight-for-height, the weight-for-age status provides essentially the same information as height-for-age. Weight-for-age is a more useful index in the serial follow-up of children in a clinical setting to detect poor weight gain.

Iron Nutrition Status

Hemoglobin and hematocrit measurements were used to screen for anemia. The CDC criterion for anemia for children <24 months of age is a hemoglobin of <11.0 mg/dL or a hematocrit of <33%. For children 2–5 years of age, the cutoff point for anemia is a hemoglobin of <11.2 mg/dL or a hematocrit of <34% (*12*). Even though there are many causes of anemia, by far the most common cause of this condition in late infancy and early childhood is iron deficiency (*13*). Other common causes of mild anemia in childhood include acute infectious illness and hereditary conditions such as thalassemia traits (*14*). However, among populations with a high prevalence of anemia, most cases are due to iron deficiency. Recent evidence suggests that black children have lower hemoglobin and hematocrit levels than do white children and that this difference is not related to iron status (*15*). Therefore, it may be necessary to consider these variations in hemoglobin and hematocrit levels when interpreting data on the prevalence of anemia among children from different racial/ethnic groups.

Breast-Feeding Status

The PedNSS collects breast-feeding data on children <24 months of age. From 1980 through 1991, breast-feeding data were reported for approximately 27% of infants monitored by PedNSS. Information on the duration of breast-feeding is of special interest, because a number of state WIC programs have recently instituted breast-feeding promotion campaigns aimed at encouraging new mothers to continue breast-feeding for at least 6 months. Additional data on infant feeding practices are not reported to PedNSS at this time.

Analysis Plan

For this report, only surveillance data collected from 1980 through 1991 for children <5 years of age were included in the analysis. Children ages 5–17 years constitute only 7% of the total records (Figure 4). Because each surveillance record represents a clinic visit, many children had more than one clinic visit in the same year. One potential problem with having multiple records per child is that the health and nutritional status of a child can be counted more than once during a 12-month period. Because it is unlikely that a child will have more than one record within a narrow age interval, using age-specific analyses with small intervals for age will address this problem. Age-adjusted prevalence estimates can then be computed for wider age intervals. However, a previous study of the PedNSS found little or no difference between the age-adjusted prevalence and the unadjusted prevalence for the same wider age intervals, because the age distribution changed very little over the years (*16*). The prevalence was also similar if only one record per child was selected instead of all records on each child. Therefore, all surveillance trend analyses presented in this report were stratified only by two large age groups: <24 months of age and 24–59.9 months of age. These values were used to define the groups because of changes in the height reference curves at 24 months of age. For birth weight analyses, for each child only the first record that contains a recorded birth weight was used.

All trend analyses start with 1980, when the PedNSS included 22 states, 12 of which participated continuously tnrough 1991. All detailed or cross-sectional analyses were based on the 1991 data. One concern is the validity of the trends in light of the increasing number of states and records from 1980 through 1991. This concern was addressed by performing trend analyses of nutritional status for the 12 states that participated consistently in the PedNSS from 1980 through 1991, compared with the overall trend of the PedNSS during the same time. In both cases, the growth and hematologic parameters showed a comparable pattern or trend; therefore, the overall analysis is presented in this report. Confidence intervals were not provided for prevalence estimates because the data sources represent a defined low-income population, not a sample. No tests of significance were performed because the large number of children in each year or subgroup causes any small difference in prevalence or mean characteristic to be statistically significant. For practical purposes, given the diversity of the data sources and changes in program and state composition within the system over time, an absolute change in prevalence of >3% and a relative change in prevalence of >20% would be of concern and would warrant further investigation.

Data Quality

Values for height and weight were missing from approximately 4.3% of the 1991 records received. Among those records that included height and weight values, approximately 7.7% had improbable values (height-for-age or weight-for-age below or above six standard deviations from the reference mean). For all analyses, records with improbable values were excluded. Nearly 20% of the hemoglobin or hematocrit values were missing because some of the WIC programs do not require anemia screening at every clinic visit.

RESULTS

Birth-Weight Status

The overall mean birth weight and rates for LBW of children in the PedNSS remained stable from 1980 through 1991, suggesting that the socioeconomic composition of the surveillance population has been stable over time. Race- and ethnicity-specific rates of LBW revealed that Asian infants appear to be the only group that had a marked reduction in LBW rate (Figure 7). Since 1983, the Asian LBW rate declined from 12% to 8%, a relative reduction of >30%, while other races and ethnic groups showed a relative change of <10%. The LBW rate was lowest for Native American infants (approximately 7%) and highest for black infants (approximately 14%).

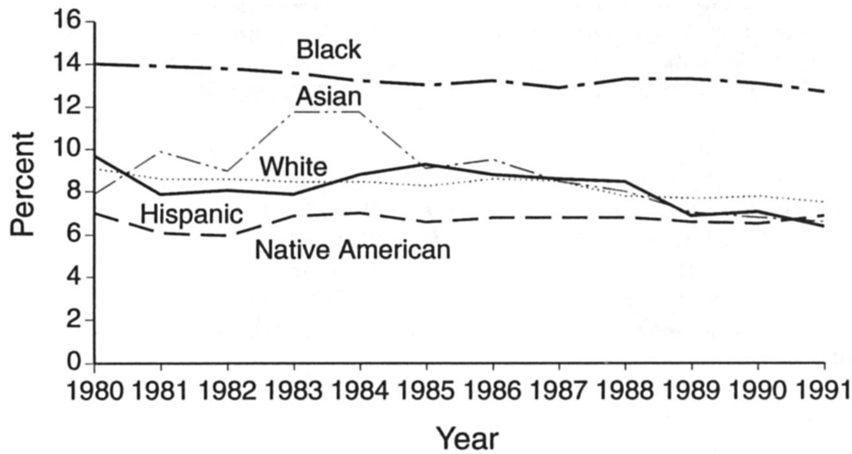
The race- and ethnicity-specific mean birth weight and LBW rates based on the 1991 data, with the exception of Asians, showed a pattern similar to that observed for all years (Table 1). There were race- and ethnicity-specific differences in the birth weight distribution. Both black and Asian infants had a lower mean birth weight than white infants. However, black infants had higher rates of LBW than white and Asian infants. The birth weight distribution for black infants showed a generalized downward shift when contrasted with the distribution for white infants. The birth weight distribution for Asian infants was similar to that for white infants at the lower end of the distribution but did not extend as far at the high end of the distribution (Figure 8).

General Nutrition Status

Height-for-Age

The overall trend of the prevalence of low height-for-age, or shortness, was stable for the time studied. With the exception of Asian children, race- and ethnicity-specific trends were also stable (Figure 9). The prevalence of stunting among Asian children <2 years of age declined from approximately 22% in 1982 to 10% in 1991, a relative reduc-

FIGURE 7. Prevalence of low birth weight among children <6 months of age — Pediatric Nutrition Surveillance System, United States, 1980–1991



tion of 54%. A similar decrease in prevalence was observed for Asian children ages 2–5 years.

The declining prevalence of low height-for-age for Asian children from 1980 through 1991 appears to result from a general upward shift in the height distribution. For example, for Asian children 2–5 years of age, the mean height-for-age Z-score in 1980 was -1.03; by 1991 it had increased to -0.33 (Figure 10). This general improvement of 0.7 in a Z-score or standard deviation over a 10-year period indicates a substantial change in the socioeconomic and nutritional status of Southeast Asian refugee families since they arrived in the United States in the late 1970s and early 1980s (*16*).

The overall prevalence of shortness for children <24 months of age was 10%, which is twice the expected level of 5%. For children 2–5 years of age, the 1991 prevalence was only slightly higher than the expected 5% level (Table 2). In general, a prevalence of low height-for-age greater than expected indicates that some of the children were

TABLE 1. Mean birth weight and rate* of low birth weight, by racial/ethnic group — Pediatric Nutrition Surveillance System, United States, 1991

	Birth weight (g)		Low birth weight
Race/ethnicity	Mean	S.D.	Rate (%)
White	3,322	593	7.5
Black	3,114	593	12.7
Hispanic	3,313	567	6.4
Native American	3,379	608	6.9
Asian	3,228	526	6.6

*Per 100 live births.

FIGURE 8. Birth weight distribution of white, black, and Asian children <6 months old — Pediatric Nutrition Surveillance System, United States, 1980–1991

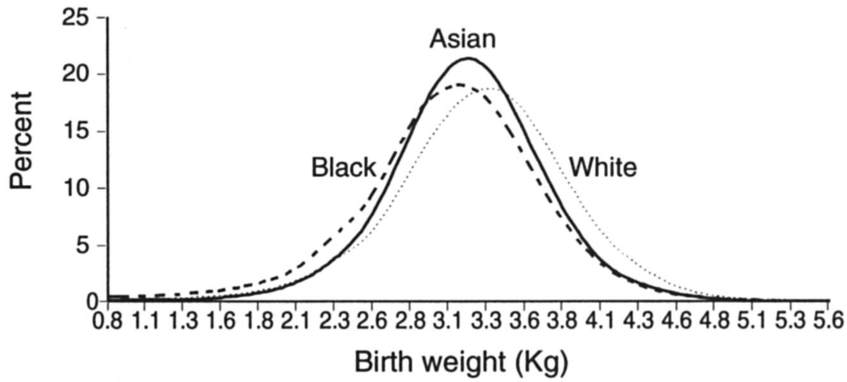


FIGURE 9. Trends in prevalence of stunting (low height-for-age) among children <2 years old — Pediatric Nutrition Surveillance System, United States, 1980–1991

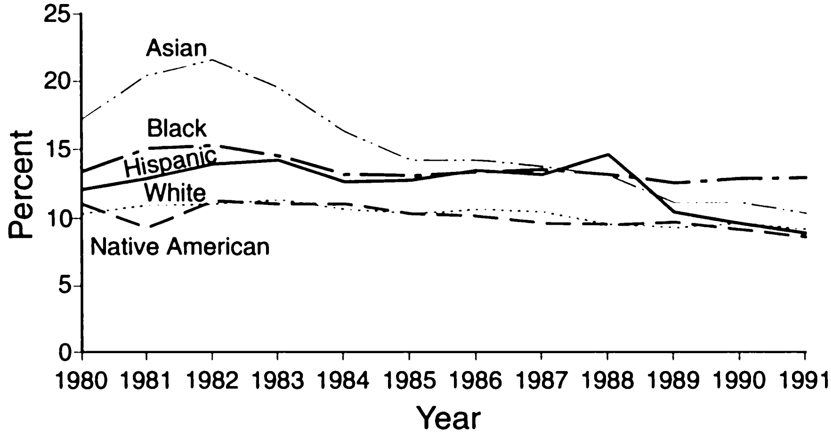
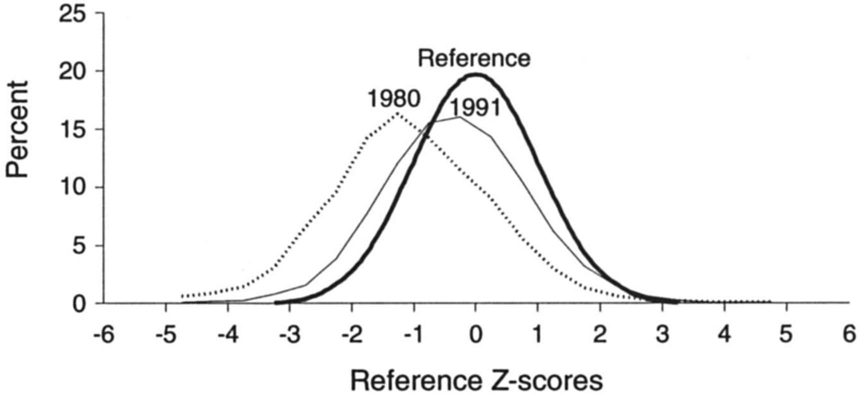


FIGURE 10. Height-for-age Z-score distribution of Asian children >2 years old, 1980 and 1991, compared with NCHS-CDC reference — Pediatric Nutrition Surveillance System, United States



NCHS = National Center for Health Statistics.

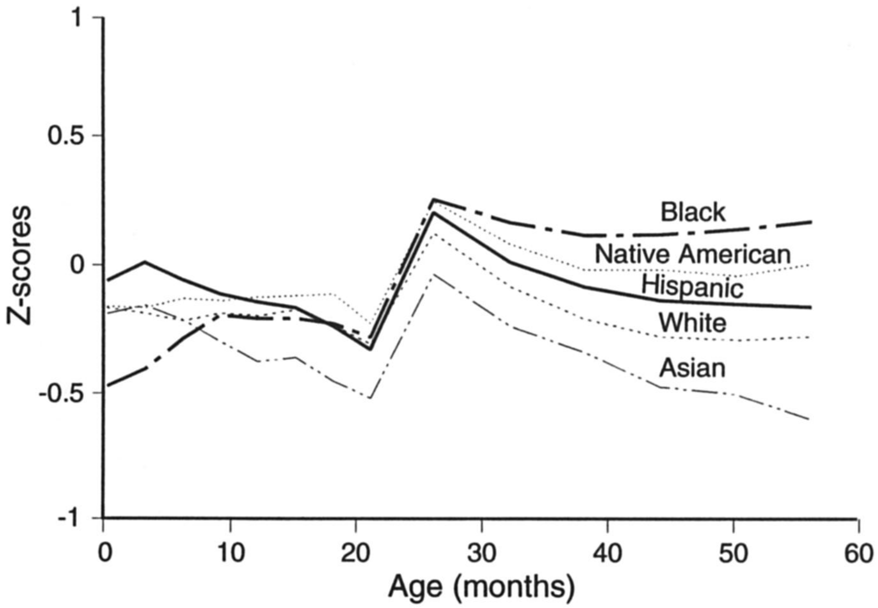
stunted because of health or nutritional reasons. As noted in the "Methods" section, some of the elevated prevalence of shortness can be attributed to the <24-month portion of the taller-than-average Fels sample used for NCHS-CDC growth reference. Some of the children monitored by PedNSS, especially those of Asian refugee background—despite marked improvement in this group since 1980—are at greater risk for stunting. These risk factors, which are commonly seen in developing countries, include inadequate nutrition and frequent childhood illness (*9*).

Race- and ethnicity-specific differences in the mean height-for-age Z-score from birth to 5 years of age were found (Figure 11). In 1991, for black children, the mean height-for-age was lowest near birth but gradually increased and surpassed that for other groups by 2 years of age. The abrupt change of mean height-for-age Z-score at

TABLE 2. Race/ethnicity-specific prevalence of short stature and mean low height-for age Z-score for children 2–5 years of age — Pediatric Nutrition Surveillance System, United States, 1991

Race/ethnicity	Prevalence (%)	Height-for-age Z-score mean	Height-for-age Z-score S.D.
White	7.7	-0.14	1.07
Black	5.3	0.17	1.15
Hispanic	7.6	-0.02	1.18
Native American	5.7	0.06	1.09
Asian	12.2	-0.33	1.17

FIGURE 11. Age-specific mean height-for-age Z-scores, by race/ethnicity — Pediatric Nutrition Surveillance System, United States, 1991



the 24-month junction is an artifact related to the different curves used to make up the height reference. (See the "Methods" section.)

Among 2- to 5-year-old low-income children monitored by PedNSS, the mean height-for-age Z-score became progressively less than the expected value of zero for the reference (Figure 12, Table 2). This finding of deteriorating height with increasing age after 2 years can be accounted for by the fact that the WIC program continues program services for those children with the greatest health and nutritional risk and that low height-for-age is one retention criterion for older children. Therefore, the observed change resulted from program selection factors rather than from a general worsening of the nutritional status of all low-income children as they grow older.

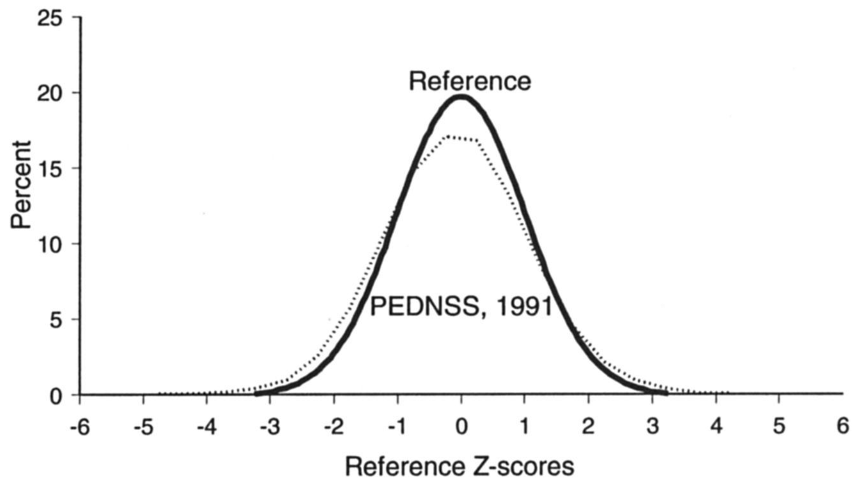
Although black children also show a slight decrease in mean height-for-age after 2 years of age, their mean height-for-age remains above the expected value of zero. This finding is of interest, since black children start out with the lowest mean height-for-age. Apparently, minor variations in childhood growth patterns exist among different racial and ethnic groups.

The height-for-age distribution for 2- to 5-year-old children in the PedNSS was slightly shifted to the left of the reference distribution. The PedNSS distribution also has a slightly wider spread, indicating a higher proportion of short and tall children; however, the difference is small (Figure 12).

Weight-for-Height

Low Weight-for-Height. The overall and race- and ethnicity-specific prevalence of low weight-for-height, or thinness, has been stable since 1980, with the exception of an increase in low weight-for-height for Hispanic children during the mid to late 1980s (Figure 13). The observed increase in low weight-for-height for Hispanic children was

FIGURE 12. Height-for-age distribution of children 25–59.9 months old, compared with the NCHS-CDC reference — Pediatric Nutrition Surveillance System, United States, 1991



NCHS = National Center for Health Statistics.

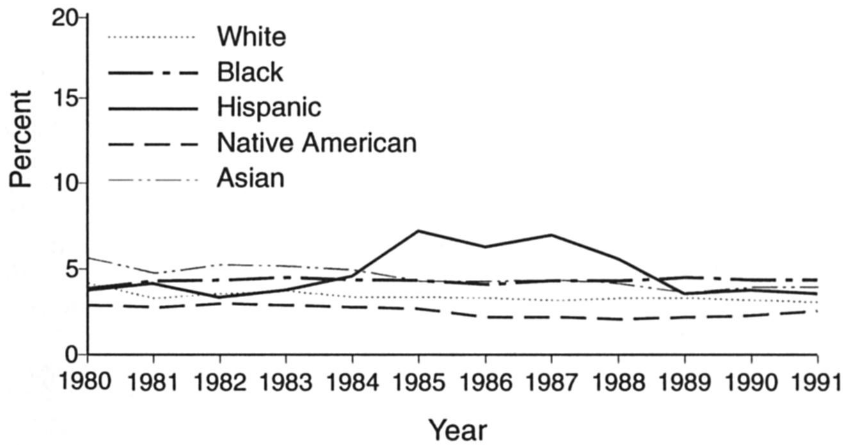
associated with the addition of Puerto Rico to the surveillance system in 1984. The prevalence of low weight-for-height decreased with the addition of Hispanic children from California (1988) and New York (1989) because of the higher weight-for-height status of these children.

With the exception of Hispanic children, the prevalence of low weight-for-height for all racial/ethnic groups is below the expected level of 5% and therefore indicates that few children monitored by PedNSS had evidence of acute or severe malnutrition (Figure 13, Table 3). The mean Z-scores of weight-for-height likewise were stable from 1980 through 1991 and near or slightly above the expected value of 0.

High Weight-for-Height. The overall and race- and ethnicity-specific prevalence of high weight-for-height or overweight has also been stable. However, from 1980 through 1991, Hispanic and Asian children showed a relative increase in prevalence of overweight of nearly 20% and 50%, respectively. During the same period, the prevalence of overweight for black and white children remained stable (Figure 14). The greater relative increase in overweight among Asian children is primarily due to a lower baseline prevalence of overweight during the early 1980s and is probably related to the general improvement in the growth status of this group. There are substantial variations in the prevalence of overweight and mean Z-scores among different racial/ethnic groups, and Hispanic and Native American children consistently had the highest weight-for-height status (Table 3).

Weight-for-Age. The overall and race- and ethnicity-specific prevalence and trend of low weight-for-age were similar to that observed for low height-for-age (Figure 15, Table 4). The trend and pattern of high weight-for-age resemble those for high weight-for-height (data not shown).

FIGURE 13. Prevalence of low weight-for-height among children <2 years old — Pediatric Nutrition Surveillance System, United States, 1990–1991



Anemia and Iron Status

Anemia was defined as either a low hemoglobin or a low hematocrit or both. Hemoglobin and hematocrit tests result in slightly different prevalence estimates of anemia for the same population. Overall, the hemoglobin-based cutoffs resulted in a higher prevalence than did the hematocrit-based cutoffs (Figure 16) because of minor differences in screening cutoff values for hemoglobin and hematocrit. The predominant procedure used for anemia screening has changed in recent years from hematocrit testing to hemoglobin testing. For this reason, the anemia prevalence based on combining hemoglobin and hematocrit results for this report was adjusted by assuming that each test contributed to half the anemia screening throughout the study period.

The 20%–30% overall prevalence of anemia for the PedNSS population was much higher than the 5% national prevalence for young children (Figure 16). A greater risk for iron deficiency among low-income children partly explains this higher prevalence. In addition, the higher observed prevalence is, to a large extent, related to the fact that the WIC program preferentially enrolls and retains children with anemia.

Since 1980, the prevalence of anemia has declined substantially. On average, most racial and ethnic groups experienced a decline in absolute prevalence of nearly 5%, which is consistent with findings from a previous study of six states that participated in the PedNSS from 1975 through 1984 (*17*). The declining trend of childhood anemia,

TABLE 3. Race/ethnicity-specific prevalence of underweight and overweight and mean weight-for-height Z-score for children 2–5 years of age — Pediatric Nutrition Surveillance System, United States, 1991

	Underweight	Overweight	Weight-for-height Z-score	
Race/ethnicity	Prevalence (%)		Mean	S.D.
White	2.5	5.7	0.11	0.95
Black	3.3	6.9	0.11	1.01
Hispanic	2.7	11.7	0.34	1.10
Native American	1.6	11.9	0.45	1.01
Asian	3.2	7.6	0.13	1.04

TABLE 4. Race/ethnicity-specific prevalence of low weight-for-age and mean low weight-for-age Z-scores for children 2–5 years of age — Pediatric Nutrition Surveillance System, United States, 1991

Race/ethnicity	Prevalence (%)	Weight-for-age Z-score mean	Weight-for-age Z-score S.D.
White	6.6	-0.10	1.06
Black	5.7	0.08	1.12
Hispanic	5.7	0.16	1.19
Native American	3.9	0.30	1.10
Asian	9.0	-0.19	1.13

FIGURE 14. Trends in prevalence of overweight among children <2 years old, by race/ethnicity — Pediatric Nutrition Surveillance System, United States, 1980–1991

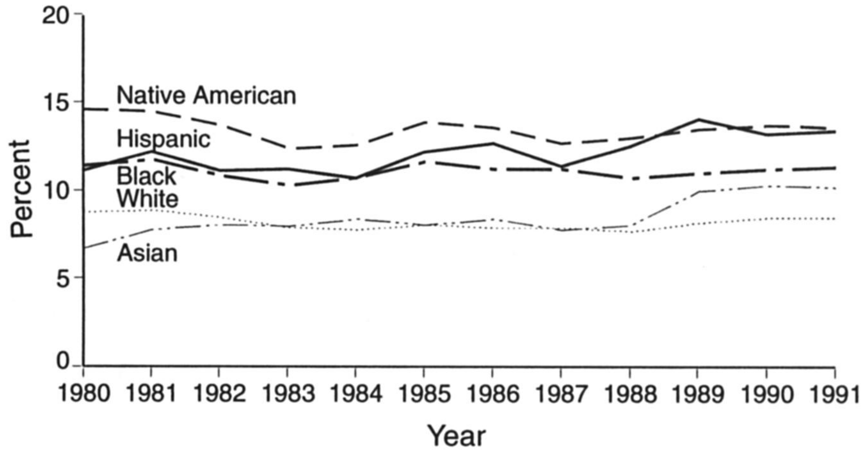


FIGURE 15. Prevalence of low weight-for-age among children <2 years old, by race/ethnicity — Pediatric Nutrition Surveillance System, United States, 1980–1991

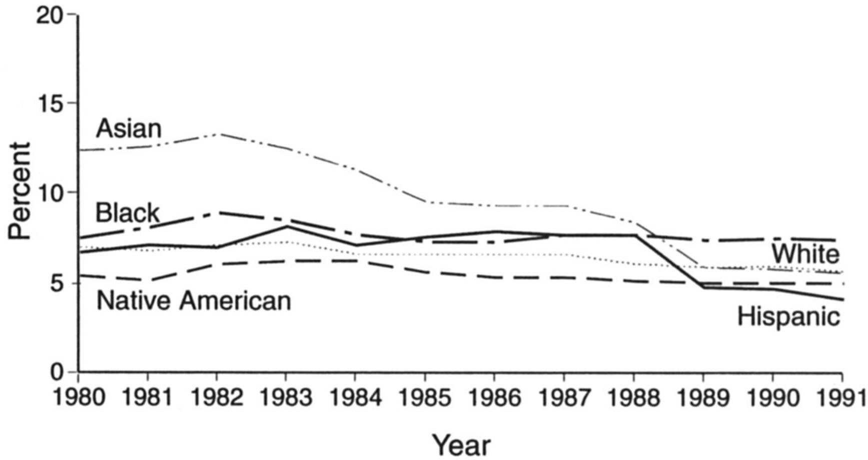


FIGURE 16. Trends in prevalence of low hemoglobin and low hematocrit among children <24 months old — Pediatric Nutrition Surveillance System, United States, 1980–1991

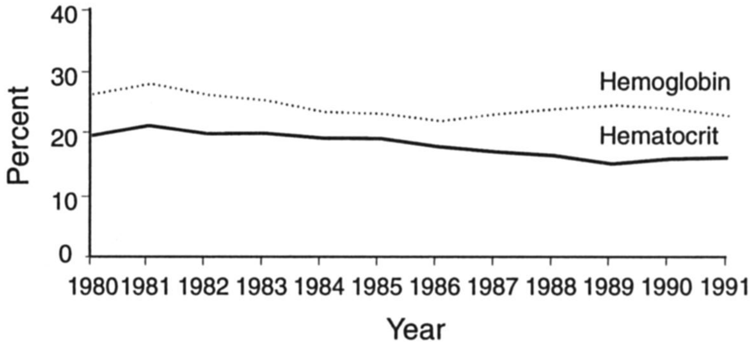
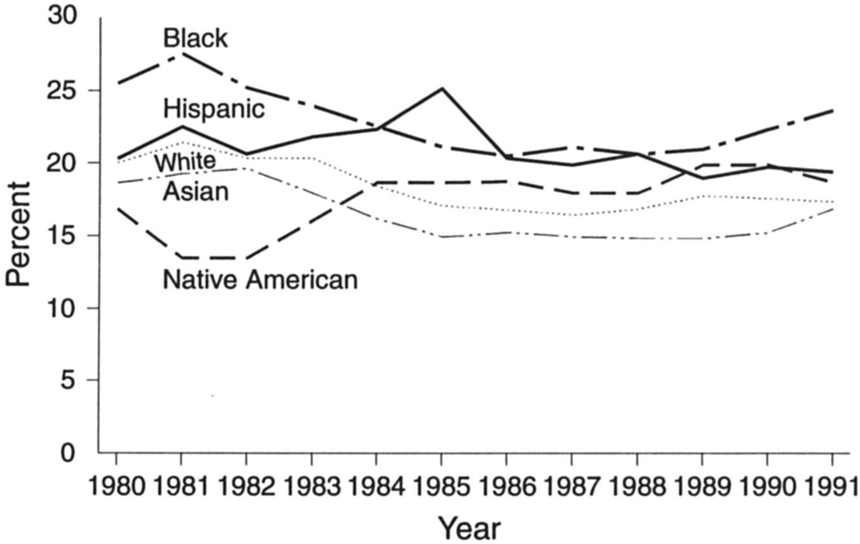


FIGURE 17. Trends in prevalence of anemia among children <2 years old, by race/ethnicity — Pediatric Nutrition Surveillance System, United States, 1980–1991



a reflection of improving iron status, was likely the result of increased use of iron-fortified foods and infant formulas.

Race- and ethnicity-specific analyses showed results similar to the overall trend in the prevalence of anemia. However, black children had a consistently higher prevalence of anemia than did other groups (Figure 17). Black children also had lower mean hemoglobin and hematocrit values (data not shown). Although black children are commonly assumed to be at a greater risk for iron deficiency, recent studies suggest that black children and adults in general have slightly lower hemoglobin levels than do whites. This difference remains even when iron status is comparable (*15*). For this reason, the higher prevalence of anemia among black children may be related to factors other than iron nutrition.

Even though anemia can be caused by many factors and the high prevalence observed in PedNSS was somewhat biased by the program selection criteria, a 20%–30% prevalence of anemia does indicate that many children monitored by the system had inadequate iron nutrition. In populations in which the prevalence of anemia is high (>15%–20%), further testing of iron status has shown that most cases (80%–90%) can be attributed to iron deficiency (*18*). These findings highlight the need for appropriate and effective prevention and intervention efforts to lower the prevalence of iron deficiency among low-income children.

Breast-Feeding

For those infants for whom breast-feeding data were reported in 1991, 36% were breast-fed at the time of hospital discharge. By 6 months of age, 15% were still being breast-fed. The pattern of breast-feeding varied by race and ethnicity: the rate of breast-feeding for black infants was only about half that for other groups (Figure 18). Native Americans had the highest rate of breast-feeding.

The year 2000 objective for the nation is to "increase to at least 75 percent the proportion of mothers who breast-feed their babies in the early postpartum period and to at least 50 percent the proportion who continue breast-feeding until their babies are 5 to 6 months old" (*19*). Even though rates of breast-feeding initiation and duration among states differ, the PedNSS data indicate that substantive promotional and educational programs are required to achieve the year 2000 objective among the low-income population.

DISCUSSION

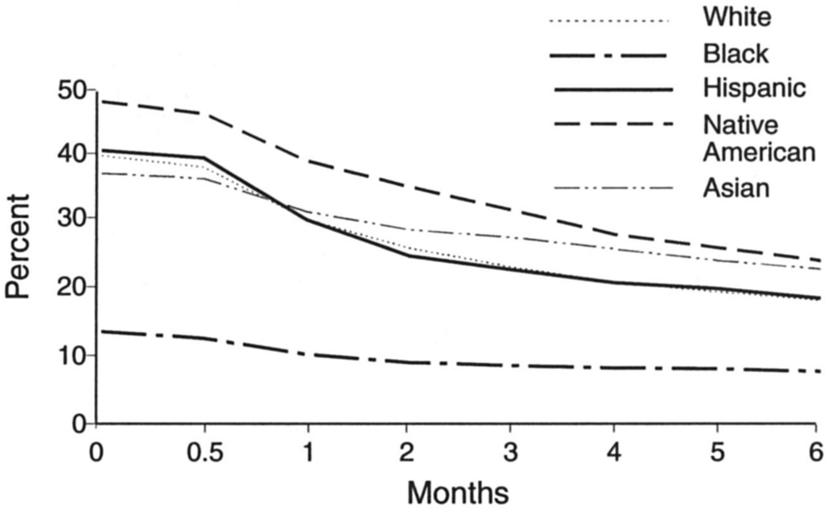
This report presents findings from the analysis and interpretation of data collected by the PedNSS from 1980 through 1991. The nutritional status of low-income children was based on the major nutrition indicators monitored by the PedNSS: birth weight, weight, height, hemoglobin status, and hematocrit status.

This surveillance system has the sensitivity to detect substantial improvement in the growth status of Asian refugee children and changes in the prevalence of anemia (*16,17*). In addition, PedNSS can provide detailed characterization of the nutritional status of low-income children for program management and evaluation.

In general, data from national surveys indicate that the nutritional status of children from low-income families is comparable with that of average U.S. children. However, the infants and children monitored by the PedNSS do have a modest increase in the prevalence of some of the key indicators such as stunting and overweight, as well as a lower rate of breast-feeding. These findings suggest that only a subset of the low-income children were being affected by greater nutritional or health risks, rather than all low-income children being affected equally. Further efforts by public health and nutrition programs to target preventive services for the subset of low-income children at greater risk may be one strategy for improving the nutritional status of low-income children.

The prevalence of stunting among children monitored by PedNSS was higher than expected, which indicates that some of the low-income children had experienced inadequate nutrition or an increased frequency of infections. The overall height-for-age distribution based on the mean height-for-age Z-score, however, was only slightly lower than that of the reference population. This finding suggests that the general nutritional status of low-income children, calculated on the basis of growth parameters, was comparable with the reference population, which was based on a representative sample of U.S. children ≥2 years of age. The marked improvement by Asian refugee children in both height-for-age and weight-for-age confirms the previous impression that general nutritional status is closely related to socioeconomic status. This improvement among Asian refugee children is related to the fact that, in contrast to their economic circumstances in Southeast Asia, their current socioeconomic condition in the United States has substantially improved, even though their income is low (*16*). By 1991, the growth status of Asian children, especially those <2 years of age, had equaled or approached that of children from other racial/ethnic groups. This improvement indicates that the lower growth status observed in earlier

FIGURE 18. Breast-feeding duration, by racial/ethnic group — Pediatric Nutrition Surveillance System, United States, 1991



years, soon after most Asian refugee families had arrived in the United States, was related to nutritional and environmental factors rather than to some genetic factor. This observation also reaffirms the concept that one growth reference can be valid for children of different racial/ethnic origins (*20*). For practical purposes, the minor variation in height-for-age observed between white and black children does not negate the use of a common growth reference.

The fact that the prevalence of low weight-for-height, an index of acute, severe malnutrition, was below the expected range confirms the impression that, in general, there is little or no evidence of severe malnutrition among low-income U.S. children related to food shortage or disease outbreaks, as is often seen during disaster conditions in developing countries.

The prevalence of anemia, however, was high among low-income children compared with prevalence based on national estimates. As discussed, one likely explanation for the high rates of anemia in the PedNSS is the preference given to anemic children for enrollment into the WIC program. The high level observed also suggests that some of the low-income children had poor iron nutrition. The high level of anemia in the population monitored by PedNSS is a cause for concern and should be acted on appropriately. Iron deficiency in childhood is associated with impaired learning and increased susceptibility to lead poisoning (*21,22*). Greater efforts toward effective prevention and interventions to lower the prevalence of iron deficiency anemia are indicated.

Although most children monitored by PedNSS are from low-income families, nutritional status varies somewhat among different race or ethnic groups. Overall, black children had the highest rates of LBW and anemia, Hispanic and Native American children had the highest rate of overweight, and Asian children had the highest rate of stunting. Substantial efforts will need to be made to reach the year 2000 target for breast-feeding rates among the PedNSS population.

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Pregnancy Nutrition Surveillance System— United States, 1979–1990

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Summary

Since 1979, the CDC Pregnancy Nutrition Surveillance System (PNSS) has monitored behavior and nutritional risk factors among low-income pregnant women participating in public health programs. Although the states contributing to the system have varied over the period, the PNSS is able to characterize the behavior and health outcomes of pregnant women from diverse low-income populations. In 1990, 66.2% of the women in the system initiated prenatal care during the first trimester of pregnancy; 26.4% smoked during pregnancy. Since 1979, the prevalence of smoking remained relatively stable for white women, but declined for blacks and Hispanics. Prepregnancy body mass index (BMI, defined as kg/m^2) showed marked changes from 1979 through 1990; the prevalence of underweight (BMI <19.8) declined steadily and the prevalence of overweight (BMI >26) increased steadily. In 1990, 39.3% of the women had gestational weight gains below levels recommended by the National Academy of Sciences. Both prepregnancy underweight and inadequate gestational weight gain were associated with greater risk for low birth weight in the PNSS. The prevalence of anemia at each trimester has remained stable since 1979. In 1990, 9.8%, 13.8%, and 33% of the women reported by the PNSS were anemic in the first, second, and third trimesters, respectively. Anemia in the first trimester appeared to be strongly associated with a high risk of low birth weight; this association was attenuated in later trimesters. These findings indicate the need to improve iron nutrition among low-income women.

INTRODUCTION

In 1979, CDC began working with five states (Arizona, California, Kentucky, Louisiana, and Oregon) to develop a system for monitoring the prevalence of nutrition problems and behavioral risk factors related to mortality and low birth weight among infants born to high-risk pregnant women. Although no state has participated in the system for the full 12-year period, by 1990 20 states participated in the Pregnancy Nutrition Surveillance System (PNSS) (Figure 1). The number of surveillance records grew from <10,000 in 1979 to >311,000 in 1990. The PNSS collects prenatal and postpartum information on women and outcome data on their infants; the data are provided by publicly funded, state-run programs such as the Special Supplemenal

FIGURE 1. States submitting records, 1979–1990 — Pregnancy Nutrition Surveillance System.

	Year											
State	**1979**	**1980**	**1981**	**1989**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**
Alaska												■
Arizona	■	■	■	■	■	■	■	■	■		■	■
California	■	■	■									
Colorado		■	■	■	■	■	■	■	■			
Connecticut				■	■	■	■	■	■	■	■	
District of Columbia				■	■	■	■	■	■	■	■	
Florida					■	■	■	■	■	■	■	■
Illinois					■	■	■	■	■	■	■	■
Indiana					■	■	■	■	■	■	■	■
Kansas					■						■	■
Kentucky	■	■	■	■	■	■	■	■	■	■		
Louisiana	■	■	■	■	■							
Maine					■				■	■	■	
Maryland					■				■	■		
Michigan		■	■	■	■							■
Minnesota		■	■	■	■						■	■
Mississippi					■						■	■
Missouri			■		■						■	■
Nebraska			■	■	■	■	■	■	■	■	■	■
Nevada				■	■	■	■	■	■			
New Hampshire					■							■
New Jersey		■	■	■	■	■	■	■	■	■	■	■
New York					■							■
North Carolina		■	■	■	■	■	■	■	■	■	■	
North Dakota					■						■	■
Oklahoma					■							■
Oregon	■	■	■	■	■	■			■			
Puerto Rico					■	■	■		■	■	■	■
Tennessee					■						■	■
Utah					■		■	■	■			■
Washington					■			■	■			
Wyoming					■					■	■	■
Number of States*	**5**	**10**	**12**	**13**	**16**	**14**	**14**	**14**	**18**	**14**	**14**	**18**
Total Records Submitted (X1000)	**10**	**14**	**22**	**25**	**30**	**80**	**66**	**69**	**95**	**66**	**69**	**95**

* Includes District of Columbia and Puerto Rico.

Food Program for Women, Infants and Children (WIC), prenatal clinics funded by Maternal and Child Health (MCH) Program block grants, and the Commodity Supplemental Food Program. Women are eligible for program benefits if their family income is below the poverty level established by state and federal governments. Agencies participating in the PNSS collect and submit standardized data to CDC. CDC then generates a series of annual tables for each state or territory in the system, summarizing nutrition-related problems and behavioral risk factors by age and race/ethnicity. More general summary tables are also produced for participating counties. These data help health professionals to manage and improve the quality of health care for low-income pregnant women.

Of the publicly funded health and nutrition programs participating in PNSS, the WIC program has been the primary source of surveillance records. In 1990, it contributed >99% of the records.

METHODS

Data

Surveillance records, compiled from data from participating programs, contain prenatal and postpartum information for each woman. When a woman first enrolls for program benefits at a participating clinic, required PNSS information is collected through the program's intake form and stored in a computerized master file at the state level. After the infant is born and the woman returns to the clinic, postpartum information on the woman and her infant(s) is collected and added to her computerized file. Records are aggregated at the state level and sent to CDC quarterly.

Various demographic, behavioral, anthropometric, nutritional, and infant outcome data are collected in the PNSS. Demographic characteristics include maternal birth date, race/ethnicity, marital status, educational status, migrant status, clinic and county identifiers, and program participation (e.g., WIC, MCH). Information about household size, monthly income, and participation in government food and medical assistance programs (e.g., food stamps, Medicaid) may be collected as optional items. Participants supply health-care and behavioral risk data during their prenatal and postpartum visits. These data include month of gestation when participation in prenatal care began, the number of cigarettes smoked/day at the time of the prenatal visit and during the 3 months before pregnancy, whether the woman stopped or decreased smoking during pregnancy, and alcohol use (number of days/week and number of drinks/day) at the time of the prenatal visit and during the 3 months before pregnancy. At the postpartum visit, information on smoking and use of alcohol during the last 3 months of pregnancy is also collected. Anthropometric data include height, self-reported prepregnancy weight, weight at the first prenatal visit, total weight gain during pregnancy, and weight before delivery and postpartum weight. Hematologic data, including hemoglobin (Hgb) or hematocrit (Hct), are required to be collected at the prenatal visit. Data about infant outcome include date of birth, sex, number of infants born, birth weight, status of the infant at birth (living or dead) and at the postpartum visit, duration of breast-feeding, and infant's age at introduction of formula.

Variables

Prenatal care

Women in the PNSS were asked in what month of pregnancy they began to receive prenatal care. In 1990, this information was available for 54% of the records.

Cigarette smoking

In 1990, many clinics in the PNSS did not collect information on cigarette smoking; smoking information was available for 38% of the records.

Alcohol consumption

The sensitivity of questions about use of alcohol, combined with the fact that PNSS first began to collect data on alcohol consumption in 1989, means that many clinics do not yet collect the data. In 1990, information on alcohol consumption before and during pregnancy was available for 36% and 26% of the records, respectively.

Prepregnancy weight status

Prepregnancy weight was evaluated on the basis of self-reported prepregnancy weight and height by using body mass index (BMI=weight [kg]/height [m^2]). Women in the PNSS were classified into one of four weight groups on the basis of criteria recommended by the Institute of Medicine (*1*): underweight, BMI <19.8; normal weight, BMI 19.8–26.0; overweight, BMI >26.0–29.0; and obese, BMI >29.0. These criteria correspond to <90%, 90%–120%, >120%–135%, and >135% of the 1959 Metropolitan Life Insurance Company's weight-for-height standards. In this report, the overweight category includes both overweight and obese women. Prepregnancy BMI was available for about 53% of the records in 1990.

Total gestational weight gain

In the PNSS, total gestational weight gain was based on self-reports of weight before pregnancy and maximum weight attained during pregnancy. Women were placed in three categories that represent total gestational weight gain at, below, or above recommended levels, taking into account their prepregnancy weight (*1*). For underweight women, the recommended weight gain range is 28–40 lb; for those who are normal weight, it is 25–35 lbs; and for those who are overweight, it is 15–25 lbs. Data on gestational weight gain were available for 33% of the 1990 PNSS records.

Anemia

Anemia was defined by CDC criteria that take into account stage of pregnancy, smoking status, and altitude (*2*). Hgb was used to define anemia if both Hgb and Hct are available. For nonsmokers residing at altitudes <3,000 ft, anemia was defined as Hgb <11.0 g/dL or Hct <33.0% in the first and third trimester, and Hgb <10.5 g/dL or Hct <31.5% in the second trimester. For 1990, anemia status can be determined for about 78% of the records.

Birth outcomes

Low birth weight is an indicator of maternal health and nutritional status during pregnancy, as well as a strong predictor of morbidity and mortality throughout infancy and childhood (*3*). Most of the birth weight data in the PNSS are self-reported by women when they return to the clinic for the postpartum visit or WIC enrollment for their infants. A previous study found close agreement between birth weights reported by parents in the Pediatric Nutrition Surveillance System and those recorded on birth certificates, with no substantial misclassification of low birth weight (*4*). Some women who have infants with severe medical conditions or with very low birth weights may not return to clinics to enroll for WIC programs. Consequently, PNSS estimates of the incidence of low birth weight, defined as birth weight <2,500 g or 5 lb 8 oz, are likely to be lower than the actual incidence for the low-income population. For this reason, the overall incidence of low birth weight was not estimated for specific racial/ethnic or age categories, and it is not discussed in this report. To evaluate relative risks, however, the incidence of low birth weight was estimated for each stratum of selected behavioral and nutritional characteristics. In 1990, birth weight information was available for 67% of the records.

Analysis

This report presents three sets of analyses for selected variables from PNSS data. First, prevalences of selected behavioral risk factors and other risk factors defined by maternal anthropometry and anemia from 1990 PNSS data were presented for four age categories (12–19, 20–24, 25–29, and 30–44 years) and for five racial/ethnic groups (white, black, Hispanic, Native American, and Asian/Pacific Islander).

Second, selected summary statistics are graphically presented for whites, blacks, and Hispanics for each year during the period 1979–1990: the percentage of women who reported cigarette smoking during pregnancy; the percentage of women who were underweight or overweight before pregnancy; and the prevalence of anemia among women who enrolled for program benefits in the first, second, and third trimesters.

Finally, the incidence of low birth weight in 1990 PNSS data is presented by race/ethnicity and by age category for women with the following characteristics: nonsmokers and smokers; nondrinkers and drinkers; women who are underweight, normal weight, and overweight; women who had gestational weight gains at, below, and above recommended levels; and women who were not severely anemic and who were severely anemic in the first, second, and third trimester. To illustrate the effect of maternal anemia on the risk of low birth weight, more stringent criteria were used to define anemia for this analysis: 1.0 g/dL below the normal Hgb cutpoint for anemia and 3% below the normal Hct criteria for anemia.

Data Quality Considerations

Given the nature of the enrollment criteria and the variety of data collection methods used in public health clinic programs, the quantity and quality of data in the PNSS vary substantially. Moreover, in many states only some of the public health clinics participate in the PNSS. Some women who are assisted as pregnant clients cannot be served postpartum because of enrollment priorities. In addition, many women in these programs are highly mobile and may move in or out of a participating service area during their pregnancies. Because women come to clinics for services at different times during and after their pregnancies, information was not available for the complete pregnancy for all women. Records on women who enter PNSS either postpartum (missing the prenatal visit) or who do not come for the postpartum clinic visit were also included. In 1990, for example, 53% of surveillance records contain data collected from both the prenatal and postpartum visits. Seventeen percent of records were from women who were enrolled after the delivery of a child; thus, those records lack some information that is usually obtained during the prenatal visit, such as anemia during pregnancy. Another 30% of records came from women who were either lost to follow-up or were no longer eligible for program benefits, and those records thus lack information that would be collected during the postpartum visit, such as birth weight or maximum maternal weight attained during pregnancy.

In 1989, CDC enhanced the PNSS data set with additional information about nutritional and behavioral risk factors during pregnancy, particularly for smoking and drinking. The time required to program the state computer systems and to train clinic staff to collect these new variables has resulted in incomplete records for 1990 in some states.

RESULTS

Demographic Characteristics

In 1990, 45% of the surveillance records came from white women, 28% from blacks, 21% from Hispanics, 2% from Asian/Pacific Islanders, 1% from Native Americans, and 3% from women of unknown race/ethnicity (Figure 2). In the early years of the PNSS, a disproportionately high percentage of surveillance records came from Native Americans and Hispanics because of participation by certain states. In recent years, blacks and Hispanics have been overrepresented in the PNSS compared with their proportion of the total U.S. population, reflecting the racial/ethnic composition of low-income families participating in public assistance programs.

The median age of women in the 1990 PNSS was 23 years. Twenty-five percent of the records come from teenagers, 34% from women ages 20–24 years, 24% from women ages 25–29 years, and 17% from women ages 30–44 years (Figure 2). From 1979 through 1990, no notable changes were observed in the median age of women in PNSS.

Behavioral Risk Factors

Prenatal care

About two-thirds of the women in the 1990 PNSS report that they began to receive prenatal care in the first trimester (Table 1). Older and white women were more likely to receive prenatal care in the first trimester than were younger women or women of other racial/ethnic backgrounds.

Cigarette smoking

In 1990, the percentage of women who reported smoking 3 months before and during pregnancy varied five- to tenfold, depending on race and ethnicity (Table 1). White and Native American women were about four times more likely to smoke cigarettes either before or during pregnancy than were Hispanic and Asian women. This variation in prevalence by racial/ethnic background persists throughout the period from 1979 through 1990 (Figure 3). The prevalence of smoking, either before or during pregnancy, increases up to ages 25–29 and declines thereafter (Table 1). Across all age groups, however, the cross-sectional prevalence of smoking declines during pregnancy compared with before pregnancy among the women participating in the PNSS. This pattern was not uniform among racial/ethnic groups, with only white and Native

American women showing a lower prevalence of smoking during pregnancy compared with before pregnancy. In 1990, women participating in the PNSS were more likely to report that they smoked during pregnancy than were all U.S. women in 1987 (*5*).

From 1979 through 1990, smoking estimates for blacks and Hispanics, but not for whites, indicated a slight downward trend. Compared with national estimates showing a decline in the prevalence of smoking during pregnancy (*6*), the decline among PNSS participants appeared to be steeper for blacks and much steeper for Hispanics. However, the prevalence among white women in the PNSS population did not decline.

Alcohol consumption

In 1990, about 14% of women in the PNSS reported having consumed alcohol in the 3 months before pregnancy, and <5% reported alcohol use during pregnancy (Table 1). Native American and white women were more likely to report drinking alcohol both before and during pregnancy. For PNSS participants overall, the prevalence of alcohol consumption during pregnancy was low and gradually increased with age. Regardless of racial/ethnic background and age, about one-third as many women reported drinking alcohol during pregnancy compared with the 3 months before pregnancy.

Maternal Anthropometry

Prepregnancy weight status

In 1990, about 20% of PNSS women were underweight, 51% were of normal weight, and 29% were overweight (Table 2). The percentages of women in each weight category varied substantially by race/ethnicity and age: Native American women were

TABLE 1. Percentage of participating women, by health-care and behavioral risk characteristics, race/ethnicity, and age — Pregnancy Nutrition Surveillance System, United States, 1990

	Received prenatal care in first trimester	Smoked		Drank Alcohol	
		Before pregnancy	During pregnancy	Before pregnancy	During pregnancy
Race/ethnicity					
White	73.9	43.2	38.6	18.9	5.9
Black	60.6	20.0	20.8	8.9	2.8
Hispanic	58.5	8.4	9.4	4.3	1.2
Native American	58.8	35.9	28.8	29.3	12.0
Asian & others	62.0	4.4	7.6	3.4	1.3
Age (years)					
12–19	61.7	29.7	22.6	10.7	2.5
20–24	66.9	32.6	26.9	15.1	4.0
25–29	69.0	33.3	29.3	15.6	5.6
30–44	67.9	30.4	27.4	14.5	5.8
All	**66.2**	**31.7**	**26.4**	**13.9**	**4.3**

FIGURE 2. Racial, ethnic, and age composition of the 1990 records — Pregnancy Nutrition Surveillance System, United States, 1979–1990

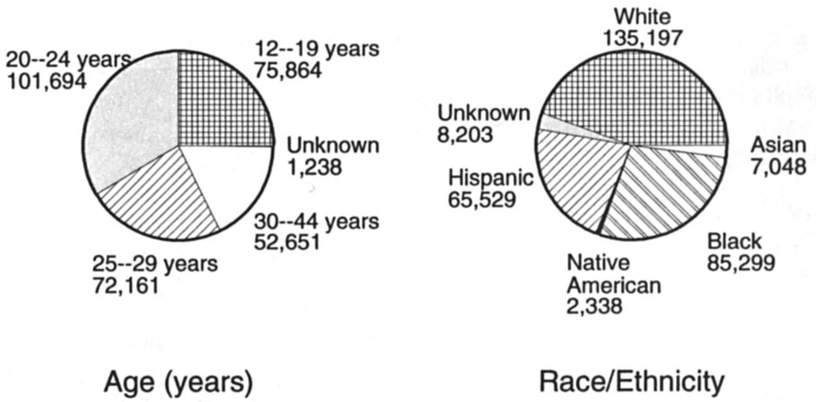
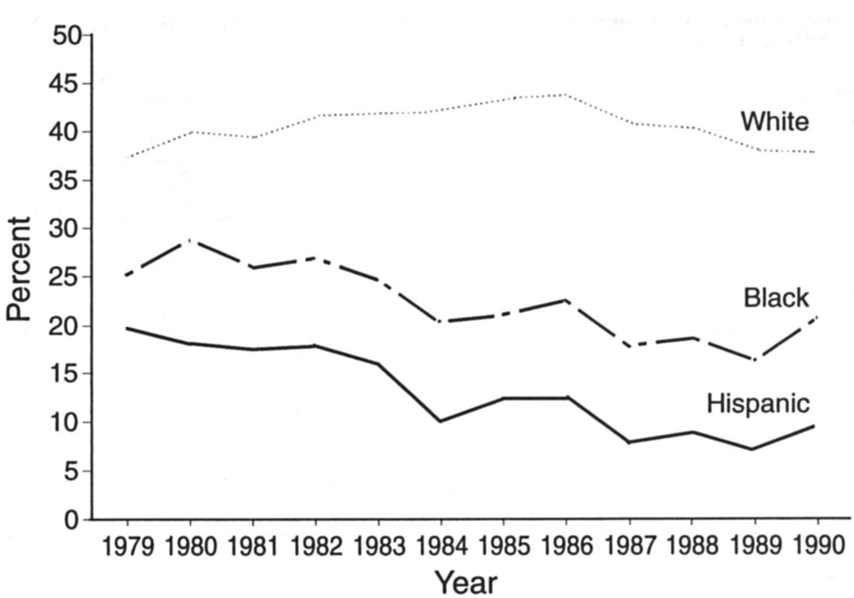


FIGURE 3. Number of current smokers at initial clinic visit, by race/ethnicity — Pregnancy Nutrition Surveillance System, United States, 1979–1990



least likely to be underweight and more likely to be overweight; younger women were more likely to be underweight and less likely to be overweight.

The percentage of women classified as underweight before pregnancy declined steadily during the period covered for all three racial/ethnic groups (Figure 4). Each year, white women were more likely than women of other racial/ethnic groups to be classified as underweight. The percentage of women classified as overweight before pregnancy increased considerably during the period for all three groups (Figure 5). Since 1983, black women were consistently more likely than white and Hispanic women to be overweight. The racial/ethnic differences in the percentage of overweight women were relatively small throughout the period, with about 30% of all three groups classified as overweight by the end of the period. The PNSS estimates are consistent with the observation that the mean BMI of young adult women in the general U.S. population increased over the period (*7*).

Gestational weight gain

In 1990, about 39% of women in the PNSS gained less weight during pregnancy than is recommended (*1*) (Table 2). Native American and Asian women were less likely to achieve the recommended gestational weight gain than were women of other racial/ethnic backgrounds. Across the four age groups, no differences were observed in the percentage of women who gained less weight than recommended.

About 33% of women gained more weight than recommended during pregnancy. White, black, and Hispanic women were more likely than Native American and Asian women to gain more weight than recommended. No age differences were observed in percentages of women who gained more than recommended. The percentage of women in the PNSS who gained weight at or more than recommended levels was

TABLE 2. Weight status of women before becoming pregnant and gestational weight gain, by race/ethnicity and age — Pregnancy Nutrition Surveillance System, United States, 1990

	Prepregnancy weight status (%)			Gestational weight gain (%)		
	Underweight	Normal	Overweight	Less	Recommended	More
Race/ethnicity						
White	22.4	50.2	27.4	40.4	27.5	32.1
Black	16.4	50.8	32.8	36.7	28.5	34.8
Hispanic	14.7	55.1	30.2	36.2	29.7	34.2
Native American	9.7	53.5	36.8	44.7	25.6	29.7
Asian & others	27.1	55.6	17.3	50.5	29.9	19.5
Age (years)						
12–19	26.1	55.0	19.0	38.2	27.8	34.0
20–24	20.0	50.7	29.3	40.0	27.8	32.3
25–29	16.1	49.3	34.5	39.4	28.3	32.3
30–44	11.6	47.7	40.7	39.0	28.9	32.7
All	**19.6**	**51.2**	**29.3**	**39.3**	**28.0**	**32.7**

FIGURE 4. Percentage of women who were underweight before becoming pregnant, by race/ethnicity — Pregnancy Nutrition Surveillance System, United States, 1979–1990

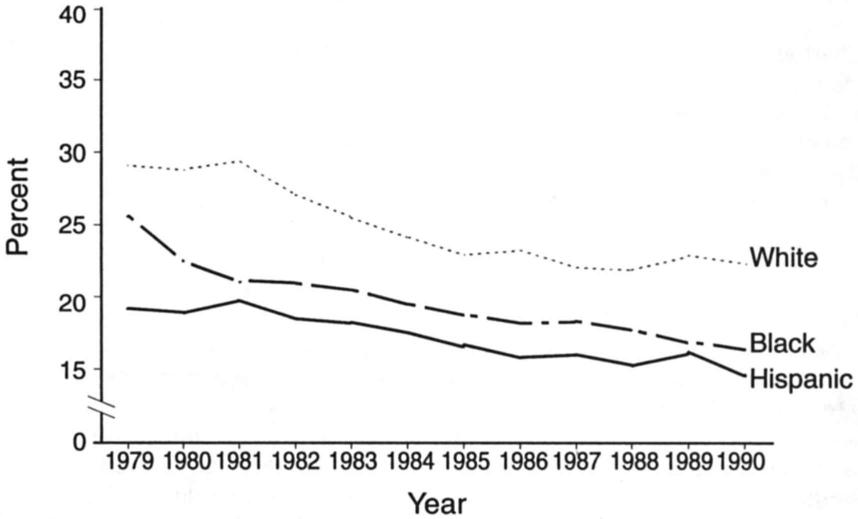
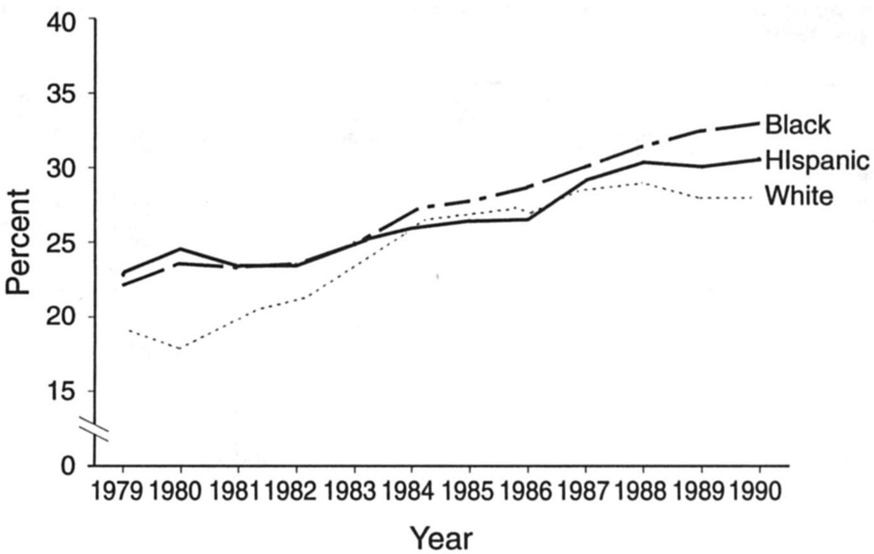


FIGURE 5. Percentage of women who were overweight before becoming pregnant, by race/ethnicity — Pregnancy Nutrition Surveillance System, United States, 1979–1990



slightly less than the 1980 national estimate of 67%, which was based on married women (*5*).

Anemia

The prevalence of anemia differs markedly among women enrolling in participating clinics at different stages of pregnancy (Table 3). This pattern of increasing prevalence of anemia as pregnancy progresses is indicative of worsening iron status throughout pregnancy. If iron nutrition or intake were adequate among most low-income women, the prevalence of anemia would be comparable across trimesters. Black women had a disproportionately higher prevalence of anemia, and white women demonstrated the lowest prevalence of anemia.

No noticeable trends were apparent in the race/ethnicity-specific or overall prevalence of anemia for the period reported. The race/ethnicity- and trimester-related differences noted in 1990 were present throughout the period. Black women, regardless of which trimester they enrolled in the program, had a higher prevalence of anemia than did either white or Hispanic women (Figure 6).

Maternal Risk Factors and Low Birth Weight

Cigarette smoking

The overall incidence of low-birth-weight infants born to women who smoked during pregnancy was 9.0/100 live births, compared with 5.2 among women who did not smoke (Table 4). Across all racial/ethnic backgrounds, pregnant women who smoked cigarettes were at higher risk of delivering a low-birth-weight infant than were their nonsmoking counterparts. The risk of low birth weight does not appear to increase by

TABLE 3. Prevalence of anemia among women who enrolled in participating clinics in the first, second, and third trimester of pregnancy, by race/ethnicity and age — Pregnancy Nutrition Surveillance System, United States, 1990

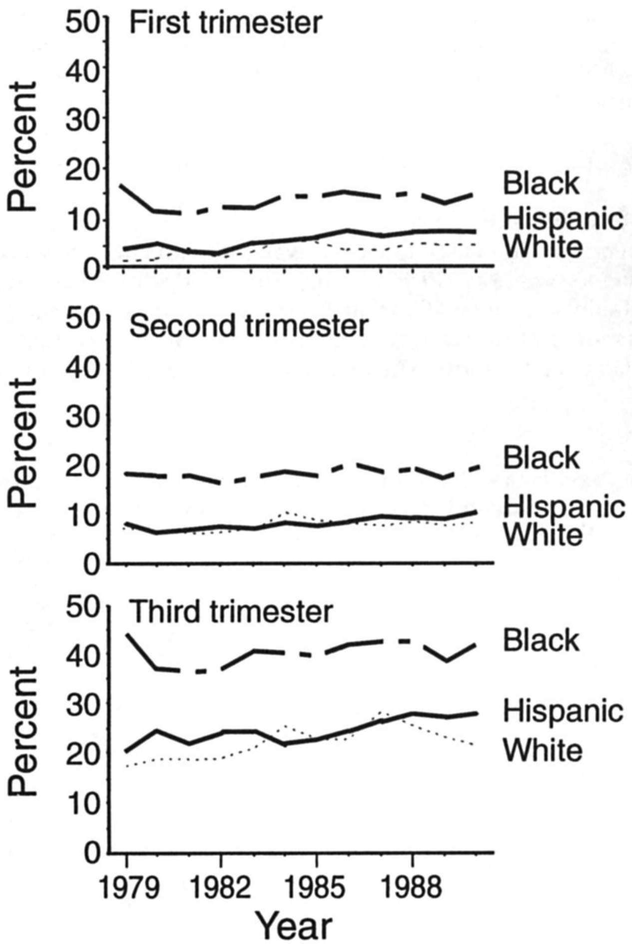
	Trimester of pregnancy		
	First (%)	Second (%)	Third (%)
Race/ethnicity			
White	6.1	9.3	24.6
Black	16.9	21.4	45.8
Hispanic	9.6	11.4	31.9
Native American	8.4	11.9	32.8
Asian & others	10.8	11.8	26.8
Age (years)			
12–19	10.8	15.9	36.7
20–24	8.9	13.5	32.8
25–29	10.0	12.7	31.5
30–44	10.0	12.8	30.2
All	**9.8**	**13.8**	**33.0**

age group among nonsmokers, but it does increase substantially among older women who smoke.

Alcohol consumption

The overall incidence of low-birth-weight infants born to women who drank alcoholic beverages during pregnancy was 7.1, compared with 6.2 among women who did not (Table 4). Black women and women 30–44 years of age who drank alcohol during

FIGURE 6. Percentage of women with antepartum anemia, by racial/ethnic group and trimester — Pregnancy Nutrition Surveillance System, United States, 1979–1990



pregnancy appeared to be at especially higher risk of delivering a low-birth-weight infant than were their nondrinking counterparts.

Prepregnancy weight status

The overall incidence of low birth weight was 10.4/100 live births for underweight women and 6.8/100 live births for women of normal weight (Table 5). The differences in the incidence of low birth weight between underweight and normal weight women were similar across racial/ethnic groups. The overall risk of delivering a low-birth-weight infant for underweight women was about 1.5 times higher than for women who were normal weight before or early in pregnancy. Regardless of age and racial/ethnic background, women who were underweight were at an increased risk of delivering a low-birth-weight infant. The overall incidence of low birth weight for overweight women was 5.5/100 live births, compared with 6.8 for normal weight women.

Gestational weight gain

The overall incidence of low-birth-weight infants born to women who gained less weight than recommended was 10.0/100 live births, compared with 5.9 for women who gained weight as recommended, for a rate ratio of 1.7 (Table 5).

The overall incidence of low-birth-weight infants born to women who gained more weight than recommended was 3.5/100 live births, compared with 5.9 for women who gained the recommended weight (Table 5). Across all racial/ethnic and age groups, the rate of delivering a low-birth-weight infant for women who gained more weight than recommended was about 0.6, compared with women who gained the recommended weight.

TABLE 4. Incidence of low birth weight/100 live births among women who smoked and who drank alcoholic beverages during pregnancy — Pregnancy Nutrition Surveillance System, United States, 1990

	Cigarette smoking		Alcohol consumption	
	Smoker	Nonsmoker	Drinker	Nondrinker
Race/ethnicity				
White	8.6	4.3	6.6	5.7
Black	15.1	9.0	14.9	10.0
Hispanic	9.4	5.5	*	5.8
Native American	6.1	3.3	*	4.4
Asian	*	5.5	*	5.6
Age (years)				
12–19	8.9	6.8	5.8	7.4
20–24	7.7	4.5	7.0	5.2
25–29	8.9	4.3	5.5	5.7
30–44	12.7	5.2	11.2	6.9
All	**9.0**	**5.2**	**7.1**	**6.2**

*Sample size too small to be reliable.

Anemia

Women with severe anemia (Hb cutoff 1 g/dL lower than the CDC criteria [*2*]) had a greater risk of delivering a low-birth-weight infant than did women who were not severely anemic (Table 6). Among women who enrolled in the PNSS in the first trimester, the overall incidence of low birth weight was 10.7/100 live births among severely anemic women and 7.0 for those not severely anemic. The risk for women in the second trimester who were severely anemic was similar to that for women in the first trimester. For women in the third trimester, however, the risk did not appear to be particularly high for severely anemic women.

DISCUSSION

From 1979 through 1990, the PNSS observed substantial changes in the prevalence of some key indicators, such as prepregnancy weight and smoking status. A variety of factors may have influenced the changes in the summary statistics presented. These factors include the rapid growth in the number of records submitted to the system; changes in state participation; changes in county and clinic participation within states; changes in program eligibility criteria for program enrollment; and differences in eligibility criteria across states as well as over time. Confirming any apparent trend or lack thereof in the statistics presented would require more information than is currently available. Despite such shortcomings, the PNSS dataset is unique in that it captures information on low-income pregnant women from diverse geographic areas.

Lack of prenatal care is closely associated with risk factors that adversely affect pregnancy outcome, such as low income, substance abuse, and adolescence. Early prenatal care is particularly important among high-risk women so that pregnancy outcomes can be improved (*8*). The overall percentage of women who received prenatal

TABLE 5. The incidence of low birth weight/100 live births, by prepregnancy weight status and by gestational weight gains — Pregnancy Nutrition Surveillance System, United States, 1990

	Prepregnancy weight status			Gestational weight gain		
	Underweight	Normal	Overweight	Less	Recommended	More
Race/ethnicity						
White	9.9	6.1	4.5	9.7	5.4	3.3
Black	13.4	10.2	8.3	15.8	9.7	5.2
Hispanic	10.5	6.4	5.8	9.4	4.9	3.4
Native American	7.2	4.2	3.7	5.1	5.4	2.6
Asian	7.4	5.1	4.5	7.1	3.7	2.5
Age (years)						
12–19	10.7	7.3	5.9	11.7	6.9	3.7
20–24	9.8	6.3	4.9	9.6	5.0	3.1
25–29	10.3	6.1	5.6	8.9	5.6	3.3
30–44	11.7	7.8	6.0	10.0	7.0	4.5
All	**10.4**	**6.8**	**5.5**	**10.0**	**5.9**	**3.5**

care in the first trimester (66.2%) was lower than the 1987 national estimate of 76% and was far from the Year 2000 objective of 90% (*5*).

Smoking is an important risk factor for poor pregnancy outcome that may be modified. Maternal smoking is associated with a variety of adverse pregnancy outcomes, including reduced birth weight, increased risk of preterm delivery, and higher rates of fetal and infant death (*9*). Cessation of smoking, either before pregnancy or in the first trimester, reduces the risk of delivering a low-birth-weight infant to that of women who have never smoked (*10*). PNSS prepregnancy smoking estimates were based on a population of pregnant women and could have declined more than national estimates, which were based on samples that include small percentages of pregnant women. Women in the PNSS may have modified either their smoking behavior or their reporting of their smoking behavior because of pregnancy.

Alcohol consumption by pregnant women is associated with fetal alcohol syndrome, fetal loss, and low birth weight (*11*). Although a national estimate is not yet available, alcohol consumption by pregnant women is considered to be declining (*12*). Data from the 1990 PNSS indicate that the overall prevalence of alcohol consumption during pregnancy was low and the prevalence was higher among older women. That an even higher percentage of white and Native American women report alcohol use before and during pregnancy represents a considerable public health problem.

Maternal anthropometric indicators, such as prepregnancy weight-for-height and gestational weight gain, are useful for screening women at nutritional risk, monitoring maternal nutritional status, and predicting adverse pregnancy outcomes, such as low birth weight (*13*). Prepregnancy underweight is an important risk factor for delivering a low-birth-weight infant, and the importance of attaining a normal prepregnancy BMI needs to be recognized among low-income women of reproductive age as well as

TABLE 6. The incidence of low birth weight/100 live births among women who were severely* anemic in the first, second, and third trimester of pregnancy — Pregnancy Nutrition Surveillance System, United States, 1990

	First trimester		Second trimester		Third trimester	
	Anemic	Nonanemic	Anemic	Nonanemic	Anemic	Nonanemic
Race/ethnicity						
White	10.3	5.9	9.0	6.5	6.7	5.6
Black	12.1	10.1	11.7	9.9	7.8	8.4
Hispanic	9.6	6.6	8.0	6.7	4.4	5.3
Native American	†	4.2	†	5.0	†	2.5
Asian	†	5.1	†	6.0	†	3.4
Age (years)						
12–19	10.7	7.9	8.6	8.4	6.2	7.3
20–24	10.3	6.4	8.8	6.8	6.6	5.6
25–29	12.6	6.6	12.0	7.1	6.7	5.5
30–44	9.1	7.3	14.3	7.9	8.2	6.5
All	**10.7**	**7.0**	**10.2**	**7.5**	**6.7**	**6.1**

* Defined by Hgb and Hct cutoff points that are 1 g/dL and 3% lower, respectively, than the CDC criteria.

† Sample size too small to be reliable.

health professionals working with these populations. The high incidence of low birth weight among this group of women in the PNSS population underscores the benefit of attaining adequate body weight before or early in pregnancy. Overweight women do not have a much lower risk of delivering a low-birth-weight infant than do women of normal weight.

Gaining less weight than recommended during pregnancy is also an important risk factor for delivering a low-birth-weight infant. Women who gain more than the recommended amount during their pregnancy had an even lower risk of delivering a low-birth-weight infant than women who gain the recommended amount. However, the benefit achieved by gaining more than the recommended amount of weight may be offset by increased risks of fetal macrosomia, labor and delivery complications, and postpartum maternal weight retention.

Severe iron deficiency anemia among pregnant women is associated with an increased risk of delivering pre-term or low-birth-weight infants (*14*). Reducing iron deficiency among pregnant women can potentially improve both the health of the infant and the iron nutrition status of the mother. Among healthy pregnant women, Hgb and Hct levels vary. These levels were elevated among smokers and among women who live at high altitudes. The substantially higher prevalence of anemia among black women could be related to iron nutrition status. However, recent evidence suggests that black women have substantially lower Hgb levels than white women, even when their iron status is comparable (*15*). For this reason, the high prevalence of anemia among black women may not be entirely related to poor iron nutrition.

Maternal anemia in the first trimester appeared to be strongly associated with a high risk for low birth weight; this association was attenuated in later trimesters. Women who enroll in the third trimester also may be more likely to have other characteristics that are related to having a low-birth-weight infant, which in turn confounds the effect of anemia. Nonetheless, the unjustifiably high prevalence of anemia in the third trimester, particularly among black women, is of public health concern and deserves further investigation of its effect on pregnancy outcome.

Despite the limitations of data collection procedures and fluctuations in participating states in the system throughout the years, the PNSS provides information valuable for characterizing and identifying high-risk low-income pregnant women. In addition, the system provides the means to monitor trends in the prevalence of pregnancy-related risk factors. Further efforts to improve the PNSS will enhance its utility.

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State and Territorial Epidemiologists and Laboratory Directors are gratefully acknowledged for their contributions to this report. The epidemiologists listed below were in the positions shown as of November 20, 1992, and the laboratory directors listed below were in the positions shown as of November 1992.

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