Nutrition

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PUBLIC HEALTH IMPORTANCE

Nutritional status is an integral component of the overall health of individuals and populations. Among children, nutritional status can affect growth, development, and resistance to disease. The main nutrition-related health problems among Americans result from overconsumption of calories, fats, cholesterol, and sodium (*1*). Although the U.S. food supply is adequate to prevent severe undernutrition and deficiency-related diseases, some subgroups of Americans have inadequate dietary intake and deficiencies in nutrients—especially iron, which continues to represent the most common nutrient deficiency (*1*). The risk of nutrition-related health problems is greatest among low-income populations, with young children being especially vulnerable (*2*).

We can assess the nutritional status of individuals and populations in a variety of ways, including dietary, anthropometric (growth), and hematologic evaluations. The CDC Pediatric Nutrition Surveillance System (PedNSS) is designed to monitor the nutritional status of low-income children served by various publicly funded health and nutrition programs. The PedNSS uses anthropometric and hematologic measurements to assess the three most common nutrition-related problems among U.S. children—linear growth retardation, overweight, and iron deficiency anemia (*3*)—as well as birth weight and breast-feeding practices.

One of the Public Health Service's year 2000 objectives for the nation is to reduce growth retardation among low-income children aged <5 years to <10% (*4*). Growth retardation or stunting is an indicator of 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. Stunted growth, however, can result from poor nutrition, an increased number of infections, or both (*2*). A poor psychosocial environment can also retard growth. Among young infants, such growth failure is associated with a generalized failure to thrive as well as short stature, whereas among older children, it primarily affects stature (*5*). The PedNSS is not designed to identify specific causes of short stature for each child under surveillance. However, on a population level, an increased prevalence of stunting generally reflects poor socioeconomic and health conditions (*6*).

Overweight or obesity can adversely affect health and longevity, and is associated with numerous chronic diseases among adults (*1*). Childhood obesity affects about 25% of children in the United States (*7*) and increases their likelihood of obesity during adulthood (*8*). Many factors—including inherited, environmental, cultural, and socioeconomic conditions—can result in excessive weight gain (*4*). The PedNSS is not designed to determine specific causes of overweight in the population being monitored; however, it does provide data on the prevalence of overweight so that high-risk population groups can be identified and targeted for intervention.

The PedNSS is also useful in identifying children at highest risk for anemia, which usually is caused by iron deficiency (*9*). Iron deficiency

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anemia is associated with impaired learning and increased susceptibility to lead poisoning (*10*). This deficiency can be prevented and treated through the consumption of adequate dietary iron, or supplementation, or both. A year 2000 objective for the nation is to reduce iron deficiency among low-income children aged 1 to 2 years to 10%, and among children aged 3–4 years to 5% (*4*).

Another national objective is to reduce the proportion of low-birth-weight births to 5% of live births (*4*). Although monitoring birth weight in the United States is not the main focus of the PedNSS, the system can provide information on low-income population groups at highest risk for low birth weight. Birth weight is an indicator of maternal pregnancy health status and a predictor of morbidity and mortality during infancy and childhood. It is also a strong predictor of later childhood growth (*11*).

The Public Health Service also recommends that 75% of newborns be breast-fed at hospital discharge and of those, 50% be breast-fed until 5–6 months of age (*4*). The benefits of breast-feeding have been emphasized by many health authorities and organizations in the United States. Human milk contains the ideal balance of nutrients, enzymes, hormones, and other substances to provide physiologic benefits for the newborn infant. Breast milk consumption and breast-feeding are effective in preventing and reducing the burden of infections in infants (*12*). Further, breast-feeding provides intense maternal-infant interaction (*4*). Therefore, breast-feeding promotion is an important component of publicly funded maternal and child health programs. For additional information about related topics and surveillance activities, see the Pregnancy-Related Nutrition chapter.

HISTORY OF DATA COLLECTION

Several national nutrition surveys have been conducted to document the health of the U.S. population: the National Health Examination Surveys (NHES I in 1960–1962, NHES II in 1963–1965, and NHES III in 1966–1970); the National Health and Nutrition Examination Surveys (NHANES I in 1971–1974, NHANES II in 1976–1980, and NHANES III, now in progress); and the Hispanic Health and Nutrition Examination Survey (1982–1984) (*13*).

The growth curves developed by CDC's National Center for Health Statistics (NCHS) evolved from NHES and NHANES I data. Specifically, the current growth curves (NCHS growth reference) published in 1979 for 2- to 18-year-old children are based on cross-sectional data collected from 1963–1975 on >20,000 children selected on a weighted sample to be representative of all children in the United States (*14*). Growth curve data for children from birth to 2 years of age included in the NCHS curves for 1979 are based on longitudinal data collected on white children in Yellow Springs, Ohio, by the Fels Research Institute between 1929 and 1978. These sex-specific growth curves, which evolved as a result of the national nutrition surveys, serve as a tool integral to the interpretation of the surveillance system. The growth curves provide a way of comparing the growth of a child with the average growth of all children in the United States. They also can be used as a screening tool to target children in need of food program support and can serve as an indicator of a program's effects on a child.

In the late 1960s, the Ten-State Nutrition Survey characterized the nutritional status of U.S. children from low-income families as being less than satisfactory (*15*). As a result, CDC began in 1973 working with Arizona, Kentucky, Louisiana, Tennessee, and Washington to develop a system for continuously monitoring the nutritional status of specific high-risk population groups (*3*). By 1992, the PedNSS had expanded to include public health and nutrition programs from 41 states, the District of Columbia, Puerto Rico, the Intertribal Council of Arizona, the Navajo Nation, and the Mt. Plains Tribes; however, the pattern of participation has fluctuated. As PedNSS coverage has expanded, so has the number of records submitted to the system each year. In 1992, CDC processed >6 million PedNSS records.

CDC SURVEILLANCE ACTIVITIES

Objectives of the System

The PedNSS is operated by CDC's National Center for Chronic Disease Prevention and Health Promotion. It is a program-based nutrition surveillance system that uses information collected by publicly funded health and nutrition programs throughout the United States and its territories. These programs include the Special Supplemental Food Program for Women, Infants, and Children (WIC), the Early and Periodic Screening, Diagnosis and Treatment Program, Head Start, and other programs funded by Maternal and Child Health Block Grants. As of 1992, 4,500 publicly funded health and nutrition clinics participated in the PedNSS. Because most of these public health programs serve low-income families, the PedNSS could be regarded as a nutrition surveillance system for low-income U.S. infants and children.

The system has three primary objectives:

- To monitor trends in the prevalence of health and growth problems among children.
- To rapidly provide summary data to participating programs for their use in program planning and evaluation.
- To promote the development and use of standardized pediatric nutrition surveillance methods.

Data Items

The PedNSS collects four types of data:

- 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).
- Anthropometric: birth weight, height, and weight.
- Hematologic: hemoglobin, hematocrit, and erythrocyte protoporphyrin levels.
- Method of feeding: whether the child has ever been breast-fed and whether the child is currently breast-fed.

The nutritional status indicators used in the PedNSS relate to the most prevalent nutritional problems and correspond to data inexpensively and routinely collected by local public health programs (*3*). For example, nearly all health-oriented programs require that children be weighed, measured, and tested to measure their hemoglobin or hematocrit levels. The WIC program specifically uses these indicators for eligibility screening.

Data Collection

In the majority of cases, local public health clinic staff collect all demographic, health, and nutrition-related information on children applying for services, using state- and program-specific protocols and forms (direct-entry computer screens are replacing paper forms). Some programs, however, rely partially on information collected by other health-care providers. For example, anthropometric and hematologic measurements are performed by private health-care providers, and the results are reported to public health clinic staff who incorporate the information into their records. A difference among WIC programs specifically is that some agencies report PedNSS data only for those children certified for WIC benefits, whereas others report data for all children applying for WIC services, regardless of their certification status. This factor should be considered when comparing data between programs.

Local clinics send completed client information to each respective state health department, which enters the information into computer databases or forwards it to private vendors that maintain state-specific databases. The PedNSS data are then downloaded onto computer magnetic tapes or diskettes for submission to CDC for analysis and inclusion in the national surveillance database, which is maintained on a mainframe computer in Atlanta, Georgia.

At CDC, a surveillance record is generated for each visit by a child to a participating program. Thus, a child with more than one visit to a clinic will have multiple records in the surveillance system. On average, 2.1 records per child are recorded in the PedNSS (*2*).

Data Quality

Each state and private vendor performs edit checks on all data submitted to the PedNSS. CDC staff then check the records for critical errors (missing key information needed by the PedNSS software) and for data with biologically implausible values (BIVs) (one chance in a thousand of being real). Records with critical errors are excluded from the database. Records containing data with BIVs are included in the PedNSS database, but the variables for these data are excluded from routine analyses.

Definitions

GROWTH INDEXES

With the NCHS growth reference (*14*), the height, weight, and age data for each child at each clinic visit are interpreted into the height-for-age, weight-for-age, and weight-for-height indexes. The growth indexes can be expressed as percentile values or standard deviation values, (Z-scores), which are more useful for statistical analysis (*16*). 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 expected mean Z-score for the reference population is zero, and the standard deviation value of the Z-score is 1.0. The Z-score of each growth index for each child is calculated as follows:

$$\text{Z-score} = \frac{\text{Observed value - Reference mean value}}{\text{Reference standard deviation value.}}$$

A corresponding relationship exists between the percentile scale and the Z-score scale.

For the PedNSS, the cutoff level of abnormal indexes is below the 5th percentile or above the 95th percentile, corresponding to Z-scores of below -1.65 and above 1.65. (Table 1). Public health programs involved in PedNSS use growth indexes for screening and evaluation. These cutoffs enable program personnel to identify children with borderline growth status. Because the defined cutoffs for the reference are the 5th and 95th percentiles, the expected baseline prevalence is 5% for either an abnormally low or high growth index. A prevalence above the baseline level of 5% would be cause for concern (*2*).

HEIGHT-FOR-AGE

Height-for-age allows us to compare a child's height with the reference height of children of the same age and sex. The NCHS growth reference curves for children <24 months of age were based on a sample of children who were taller than average U.S. children. This contributes to an observed negative Z-score, or a higher-than-expected prevalence of low height-for-age, for average children 1–2 years of age (*17,18*). For children ≥2 years of age, the NCHS growth reference curves were based on a representative sample of U.S. children. As a result, the expected rate of low height-for-age for children ≥2 years of age is 5%.

TABLE 1. Criteria for anthropometric indexes used in the Pediatric Nutrition Surveillance System

		Defining cutoff	
Indexes	Measurement parameter	NCHS* percentile	Z-score
Stunting, shortness, or linear growth retardation	Height-for-age	<5th	<-1.65
Overweight	Weight-for-height	>95th	>1.65
Thinness	Weight-for-height	<5th	<-1.65

* National Center for Health Statistics pediatric growth reference (14)

The difference in height characteristics between the Fels sample and the U.S. sample also causes an abrupt change in the prevalence of low height-for-age and mean Z-score when children reach 2 years of age (*18*).

WEIGHT-FOR-HEIGHT

Weight-for-height is an expression of weight in relation to height, or an index of body mass. High weight-for-height indicates overweight as a proxy for obesity (increased fat mass).

Low weight-for-height, or thinness, is often associated with recent severe disease. In developing countries, thinness indicates acute malnutrition, which is commonly the result of insufficient food supply, infectious disease, especially diarrheal disease, or both (*2*). The prevalence of thinness in a population is usually low except during disaster conditions, such as famine and war, that result in severe food shortages and disease outbreaks.

Although weight-for-age is summarized in the PedNSS data, this index is not as easy to interpret as height-for-age or weight-for-height. Low weight-for-age could result from either chronic or acute short-term problems. A high weight-for-age could indicate obesity or a proportionate but large child. Thus, weight-for-age is not an indicator of primary focus in the PedNSS.

IRON DEFICIENCY ANEMIA

Both hemoglobin and hematocrit measurements are used by public health programs to screen for iron deficiency anemia. The CDC criteria for anemia are based on NHANES II data (*19*). For children <24 months of age, the cutoff is a hemoglobin measurement of <11.0 g/dL or a hematocrit of <33%. For children 2–5 years of age, the cutoff is a hemoglobin measurement of <11.2 g/dL or a hematocrit measurement of <34% (*19*).

LOW BIRTH WEIGHT

Low birth weight is defined as a birth weight <2,500 g (5 lbs, 8 oz). Although the PedNSS birth-weight data are reported by parents, a study comparing birth weights recorded in the PedNSS with those on birth certificates found close agreement between the two data sources. No significant misclassification of low birth weight was found (*20*).

BREAST-FEEDING

For the PedNSS, WIC programs are encouraged to collect breast-feeding information on children up to 2 years of age. WIC programs define a breast-fed child as one who receives breast milk at least once a day. Because the year 2000 breast-feeding objective refers to exclusive breast-feeding, rather than breast-feeding once a day, national breast-feeding prevalence and patterns reported through the PedNSS may be somewhat misleading. However, the PedNSS breast-feeding data are useful for states and local programs that conduct and evaluate breast-feeding promotion projects.

Data Reporting

A key component of any surveillance system is to promptly and routinely provide summary data to local program leaders so that they can use the information for program planning and evaluation. CDC sends monthly, semiannual, and annual PedNSS reports to participating states.

The two monthly reports provided to each clinic include lists of all children with one or more **high/low** nutritional status indicators and the **clinic error** reports. The **high/low** lists are designed primarily for use in the follow-up of children at nutritional risk. The **clinic error** lists are designed to identify and follow up records with critical errors or BIVs.

The semiannual and annual reports include data tables summarizing the distribution, prevalence, and trends of various demographic and nutritional status indicators, by clinic, county, and state and for all participating states and territories. In addition, annual reports to participating states include graphic illustrations of the PedNSS data.

GENERAL FINDINGS

Although the PedNSS has operated since the early 1970s, the major findings presented in this chapter are based on data for the years 1980–1991. Birth weight data are not reported.

Height-for-Age

In 1991, the overall prevalence of stunting for PedNSS children <24 months of age was 10%—twice the expected level of 5%. For children 2–5 years of age, the prevalence was 7.1% slightly higher than the expected 5% level. In general, a greater-than-expected prevalence of low height-for-age indicates that some of the children were stunted because of health reasons, nutritional reasons, or both (*2*).

Only long-term and significant changes in environmental factors, nutritional status, and health status can affect the height distribution in a population (*2*). Over the last decade, the prevalence of low height-for-age has been stable among the populations monitored by the PedNSS. However, among children of Asian descent, mostly Southeast Asian refugees, we observed a substantial decrease in the prevalence of low height-for-age. Among Asian children <2 years of age, the prevalence of stunting declined from approximately 22% in 1982 to 10% in 1991—a relative reduction of 54%. A similar decrease in prevalence was observed for Asian children aged 2–5 years (*2*).

The improvement in the height-for-age index for Asian children from 1980 to 1991 was associated with a general upward shift in the height distribution; 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 1) (*2*). This improvement of 0.7 in Z-score over a 10-year period indicates a significant change in the nutritional, health, and socioeconomic status of Southeast Asian refugee families since their arrival in the United States in the late 1970s and early 1980s (*21*). Thus, a genetic factor was not the main reason for the shorter stature observed among Southeast Asian refugee children soon after they arrived in the United States (*2*). This observation supports the concept that one growth reference can be valid for children of different racial and ethnic origins (*22*).

In our assessment of race- and ethnicity-specific patterns in height-for-age from birth to 5 years of age (Figure 2), we found that black children had the lowest mean height-for-age near birth when compared with other groups. However, by 2 years of age, they had the highest mean

FIGURE 1. Height-for-age Z-score distribution of Asian children >2 years old compared with NCHS growth reference — United States, 1980 and 1991

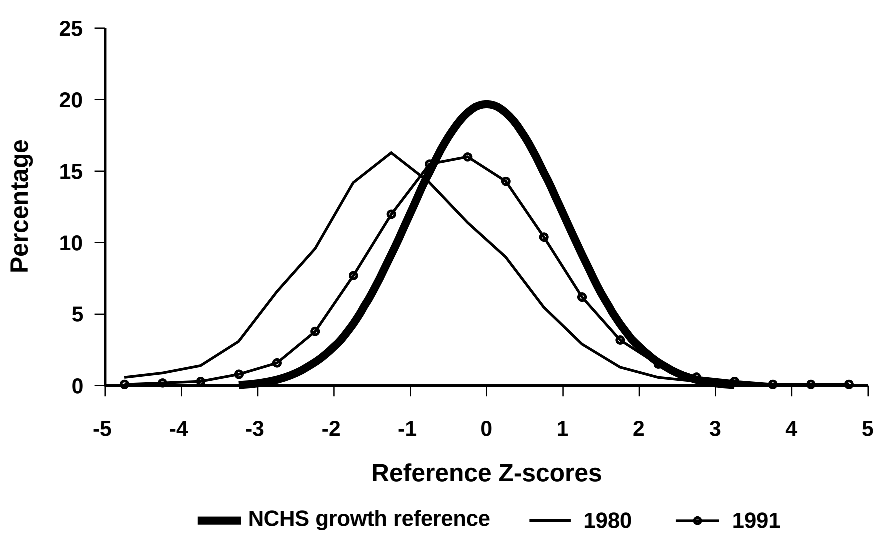
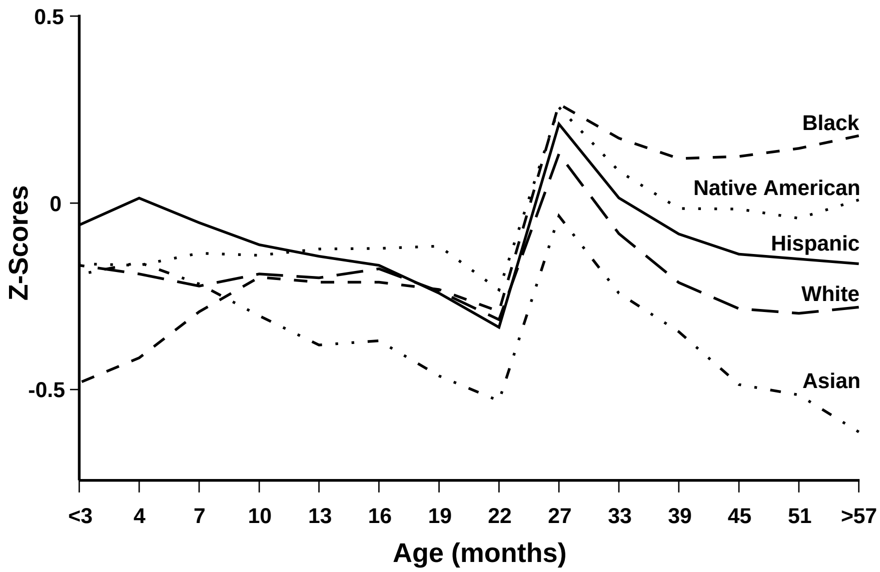


FIGURE 2. Age-specific mean height-for-age Z-scores for children ≤ 5 years of age — United States, 1991



height-for-age, indicating possible minor variations in childhood growth patterns among different race and ethnic groups. However, for practical purposes these variations do not negate the use of one common growth reference (*2*).

The abrupt change of mean height-for-age Z-scores for all groups at the 24-month juncture (Figure 2) is an artifact related to the use of two different population samples to determine the NCHS growth reference.

The WIC program preferentially retains those children with the greatest health and nutritional risks; low height-for-age is one retention criterion for older children. Therefore, the progressively lower mean height-for-age Z-score among 2- to 5-year-old children monitored by PedNSS (Figure 2) is more likely related to public health program selection factors than to a general worsening of the nutritional status of PedNSS children as they age (*2*). Also, in the NHANES II data set, the inconsistency of measuring the supine and standing height of children 24–36 months of age may have affected the growth curves.

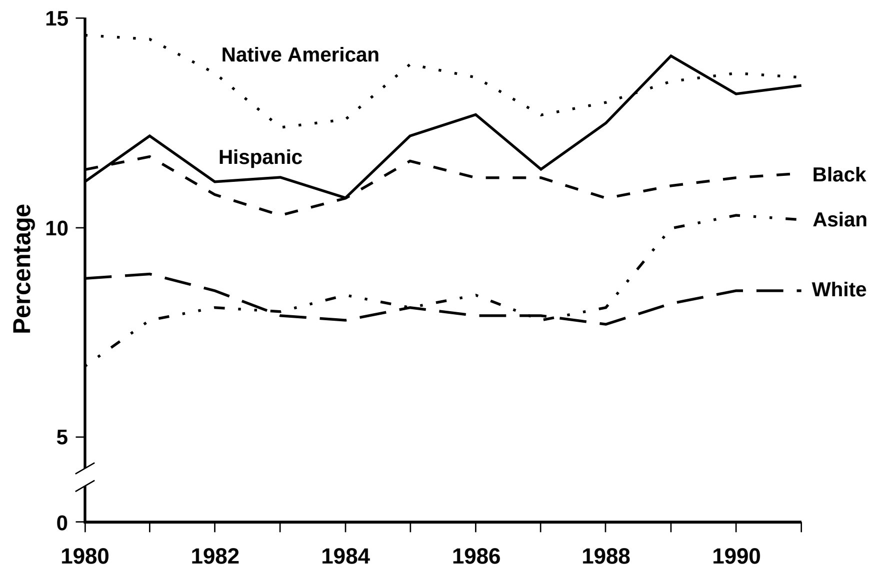
In an earlier study of PedNSS data, investigators evaluated the influence of altitude on childhood growth in the United States (*23*). When they analyzed data from eight mountain states and controlled for confounding factors, they found that the height of children was significantly shorter starting at an elevation of >1,500 meters. Therefore, when comparing nutritional survey or clinical assessment data obtained in areas of moderately high altitudes with data from lower altitudes, we must consider the effect of potential altitude-related growth retardation.

Weight-for-Height

OVERWEIGHT

Overall, the prevalence of high weight-for-height has remained stable among the children monitored by PedNSS. However, from 1980 to 1991, the prevalence of overweight increased by nearly 50% among Asian children and nearly 20% among Hispanic children (Figure 3) (*2*). The relative increase in overweight among Asian children was primarily related to a lower baseline prevalence of overweight during the early 1980s and a general improvement in the growth status of this group (*2*). Reasons for the increase among Hispanic children are not clear and need further study.

FIGURE 3. Prevalence of weight-for-height above the 95th percentile among children < 2 years old — United States, 1980–1991



Although the prevalence of overweight was stable among Native American children monitored by the PedNSS, this population has consistently exhibited the highest weight-for-height Z-scores (Figure 3 and Table 2). Other studies have indicated a very high prevalence of obesity among Native Americans of all age-groups, and it appears to begin in early childhood or even in the intrauterine period (*24*). Even though genetic predisposition is a significant factor in obesity among Native Americans, environmental factors such as inappropriate diet and physical inactivity have contributed substantially to the epidemic (*24*). Culturally appropriate interventions are needed to prevent and treat obesity at a young age in this population.

THINNESS

Among children <2 years of age, the overall prevalence of weight-for-height below the 5th percentile has been <5% during 1980–1991, and the mean weight-for-height Z-score has remained near or slightly above the expected value of 0.0. This finding indicates that few children have suffered from acute or severe malnutrition (*2*). However, the prevalence of low weight-for-height among Hispanic children increased during 1985–1988, primarily because Puerto Rico was added to the surveillance system in 1984 (more Hispanic children in Puerto Rico are thin compared with those living in the contiguous United States). Because Puerto Rico added a significant number of thinner Hispanic

TABLE 2. Race- and ethnic-specific prevalence of underweight and overweight and mean weight-for-height Z-scores among children 2–5 years of age — Pediatric Nutrition Surveillance system, 1991

	Prevalence (%)*		Weight-for-height Z-score	
	Underweight	Overweight	Mean†	SD§
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

* The expected prevalence is 5%; values of <5% indicate a less-than-expected prevalence.

† A Z-score of zero would be equivalent to the 50th percentile. Values greater than zero indicate a mean weight-for-height above the 50th percentile. A Z-score of 1.00 would be equivalent to the 84th percentile.

§ SD, standard deviation.

children to the PedNSS database, the prevalence of low height-for-age among that ethnic group increased. With the addition of California to the PedNSS in 1988 and New York in 1989, the prevalence of low weight-for-height among Hispanics decreased because Hispanic children from those two large states have a higher weight-for-height status (*2*).

Iron Deficiency Anemia

A detailed study of six states consistently participating in the PedNSS from 1975 to 1984 revealed a significant decline in the prevalence of iron deficiency anemia (*25*). Among children <2 years of age monitored by the PedNSS, anemia declined from 23.3% in 1981 to 19.6% in 1991, reflecting a relative decrease of 16%. A similar trend was evident among children 2–5 years old (*2*). A decline in the prevalence of anemia also occurred among most race and ethnic groups. Black children monitored by PedNSS consistently had a higher prevalence of anemia than the other groups. They also had lower mean hemoglobin and hematocrit values (*2*). Recent studies indicate that black children and adults have a slightly lower hemoglobin level than their white counterparts, even when iron status is comparable. This indicates that the higher prevalence of anemia among blacks may be related to factors other than iron nutrition (*26*).

Although the current prevalence of anemia among PedNSS children is lower than in previous years, it is much higher than the expected prevalence of 5%, primarily because the PedNSS monitors a low-income, high-risk population and the WIC program preferentially enrolls and retains children with anemia. Despite these factors, we have a substantial need for appropriate and effective prevention and treatment programs to reduce the risk of iron deficiency among low-income children in the United States.

Breast-Feeding

The quality of breast-feeding data varies from state to state. Overall in 1991, about 28% of records for children 6–8 months old included breast-feeding information. This amounted to 133,741 records. Among those children, 34.5% were being breast-fed on the date of hospital discharge whereas 17% were consuming some breast milk at 6 months of age. Because a large number of records lacked breast-feeding information, these prevalence data do not likely represent the entire population being monitored. However, states that have more complete information (infant feeding data for >90% of records) can assess breast-feeding prevalence and duration among the low-income children monitored by the PedNSS. In any event, the available data indicate that the level of breast-feeding among low-income infants is significantly lower than the national average. Thus, greater effort must be made to promote breast milk as the preferred source of nutrition for young infants.

INTERPRETATION ISSUES

Public Health Implications

The purpose of the PedNSS is to efficiently and rapidly provide information on gross trends regarding the nutritional status of low-income children to allow for planning, implementing, and evaluating intervention programs. The PedNSS is not designed to provide specific details; rather, it provides a broad picture. If significant positive or negative changes in trends are noted, follow-up investigations are conducted.

After comparing PedNSS data with national survey findings, we have found that the nutritional status of low-income children monitored by the PedNSS is comparable with that of average U.S. children. However, these low-income children do have an increased prevalence of key nutritional status indicators such as stunting, overweight, and anemia.

The high prevalence of overweight among low-income Native American children and the increasing prevalence of overweight among low-income Hispanic children are of concern. At present, effective public health intervention strategies to prevent and treat overweight are not available. Because significant association exists between childhood and adult obesity, and because adult obesity is a risk factor for numerous chronic diseases, appropriate interventions should be developed to address weight control among low-income children. Among Native American populations specifically, we have witnessed a growing epidemic of diabetes mellitus type II that may be related to obesity (*24*). Thus, programs must be developed to prevent and ameliorate obesity among Native Americans as a means to reduce morbidity and mortality associated with diabetes and other chronic diseases.

The high rate of anemia among the low-income children monitored by PedNSS suggests that they probably have poor iron nutrition, as has been shown in other research (*9*). Because iron deficiency in childhood is associated with impaired learning and increased susceptibility to lead poisoning (*10*), greater efforts toward effective prevention and interventions are needed. One important issue to be addressed at the state level is the standardization of screening procedures and cutoff values for anemia across public health programs and private health-care providers. Anecdotal reports from states indicate that private physicians rarely accept the results of anemia screening performed by public health clinics. Thus, patients are confused as to their health status, and appropriate follow-up of at-risk individuals is jeopardized.

Overall, the data indicate that nutritional status varies among different race and ethnic groups monitored by the PedNSS. Black children have the highest rates of low birth weight and anemia; Hispanic and Native American children have the highest rates of overweight; and Asian children have the highest rate of shortness.

Currently, the PedNSS is the only system in the United States that allows continuous monitoring of the overall nutrition-related health status of infants and children. Because the level of major nutritional status indicators in the system is similar to the level of indicators among U.S. children in general, PedNSS findings and trends may very well reflect the nutritional status of all children. In fact, the declining prevalence of anemia was first observed in the low-income PedNSS population and later confirmed in the general population.

Advantages and Disadvantages

To date, the PedNSS has been a very successful surveillance system, processing >6 million records annually. Data collection is simple, and reporting is rapid. Increasing automation and computer capabilities at the state and local levels will further enhance these features.

Because the PedNSS is designed to rapidly monitor the nutritional status of the target population and provide a broad picture, it lacks some of the detailed information that could be used to more fully interpret some of the findings. For example, the system does not discriminate among causes of low height-for-age such as genetic variations, inadequate diet, or certain medical conditions. Children with special needs, such as handicaps or developmental delays, may be included in the PedNSS and represent a subpopulation with indicators outside cutoff limits for reasons other than poor nutrition. Thus, local programs that serve significant numbers of this subpopulation need to interpret their PedNSS data accordingly and only compare their data with those of other similar programs.

Because the system is program-based, changes in an individual state program can affect the data for that state and, to a lesser degree, national data. Changes in technology, such as programs converting from one method of hemoglobin testing to another, could affect the data on prevalence of anemia. Therefore, a systematic process of maintaining up-to-date information for all programs participating in PedNSS is needed to overcome this limitation.

EXAMPLES OF USING DATA

State health departments have used PedNSS data in a variety of ways:

- To quantify nutritionally at-risk populations so as to obtain state funds for the WIC program.
- To assist with annual program planning required by the WIC program.

- To conduct program evaluations of factors such as population coverage and targeting.

- To identify the training needs of public health personnel.

- To present results in statewide public health-related conferences.

Alaska has made extensive use of the PedNSS data. The Nutrition Services Unit of the Alaska Department of Health and Social Services has used PedNSS data to determine the most effective way to direct health promotion resources and efforts through routine program planning channels. Unit staffers have used the surveillance information to evaluate the quality of anthropometric measurements and to identify specific nutrition-related problems among the children under surveillance. Using information derived from the PedNSS data, they targeted nutrition interventions to reach children with low hemoglobin concentrations and WIC mothers to increase breast-feeding incidence and duration. Alaska also uses the PedNSS data to monitor the accuracy of local WIC data and to evaluate outcomes of program interventions. The PedNSS results may also help state and local WIC advocates obtain program funding.

In addition, Alaska has used the PedNSS data in conjunction with data from the Pregnancy Nutrition Surveillance System and the Behavioral Risk Factor Surveillance System to provide a statewide nutrition prospective for baseline information to establish nutrition objectives for *Healthy Alaskans 2000* (*27*). A nutrition community work group has selected seven of the national year 2000 nutrition objectives to target in the state's comprehensive health plan, which is being finalized for public comment and acceptance.

At the national level, the PedNSS has been used in two ways:

- To monitor our progress toward meeting the year 2000 objectives for the nation.

- To demonstrate the WIC program's effectiveness in reducing the prevalence of anemia.

FUTURE ISSUES

CDC continuously strives to improve the PedNSS by improving the efficiency of data reporting, making reports more user-friendly, exporting PedNSS software to more states, and widely distributing graphic illustrations of the data. A number of future improvements are also planned:

- Adding dietary assessment variables to the PedNSS.

- Incorporating the PedNSS into lead screening programs.

- Screening to detect risk factors for chronic diseases, such as high cholesterol.

- Expanding the PedNSS to cover other pediatric populations such as schoolchildren.

- Linking PedNSS data to vital statistics data at the state level for expanded use of surveillance data.

- Standardizing data collection techniques (e.g., direct measurement of all children).

- Standardizing the use of specific reference standards for hemoglobin and hematocrit measurements.

This surveillance system is flexible and allows states and local programs to monitor specific health and nutritional parameters that are not routinely included in the PedNSS. Data fields referred to as **state use fields** can be used to code such parameters. For example, if a state were interested in monitoring breast-feeding patterns, it might want to include the education level of the mother as a question to be asked in the **state use field**.

The national WIC program and Maternal and Child Health Block Grant requirements call for better data collection and monitoring by state public health programs. The PedNSS readily serves as a data source to assess current nutrition status profiles of low-income children at the state and local levels and to continuously and inexpensively monitor trends in the prevalence of various nutritional status indicators. In addition, CDC plans to help state health departments to better use the PedNSS in evaluating specific nutrition-related activities such as iron deficiency anemia intervention projects and breast-feeding promotion campaigns.

Overall, the size of the database makes the PedNSS a very robust surveillance system. Expanding it to school systems and more public health programs such as Head Start and the Early Periodic Screening, Diagnosis, and Treatment Program, which only require income eligibility, would provide data on a broader segment of children and permit the follow-up of cohorts to evaluate the long-term effectiveness of intervention programs.

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