19-12. Reduce iron deficiency among children and females of childbearing age.

19-12c. Nonpregnant females aged 12 to 49 years.

National Data Source	National Health and Nutrition Examination Survey (NHANES), CDC, NCHS
State Data Source	Not identified.
Healthy People 2000 Objective	Adapted from 2.10 (Nutrition).
Changes since the 2000 Publication	None.
Measure	Percent.
Baseline (Year)	11 (1988-94)
Target	7
Target-Setting Method	Better than the best racial/ethnic subgroup. For a discussion of target-setting methods, see Part A, section 4.
Numerator	Number of nonpregnant females aged 12 to 49 years with abnormal results for two or more of the following tests: serum ferritin, free erythrocyte protoporphyrin, or transferring saturation.[1, 2]
Denominator	Number of females aged 12 to 49 years.
Population Targeted	U.S. civilian, noninstitutionalized population.
Questions Used to Obtain the National Baseline Data	Not applicable.
Expected Periodicity	Periodic.
Comments	Blood was collected by phlebotomy. Transferrin saturation was calculated by dividing serum iron by total iron binding capacity. Serum iron and total iron binding capacity were measured colorimetrically (by Alpkem RFA analyzer, Clackamas, Oregon), and 1

percent thiourea was added to complex copper to prevent copper interference.[3] Free erythrocyte protoporphyrin was measured via fluorescence extraction,[4] and serum ferritin was measured with the BioRad Quantimmune IRMA kit (BioRad Laboratories, Hercules, California) in NHANES III and NHANES 1999-2002 and with the Roche/Hitachi 912 clinical analyzer (Roche Diagnostics, Indianapolis, IN) in NHANES 2003-2006.

Iron deficiency is defined as abnormal results for two or more of the following tests: serum ferritin, free erythrocyte protoporphyrin, or transferrin saturation. The basis of the use for two of three abnormal tests was the finding that populations with only one abnormal test of these three had scarcely more anemia than those with all normal test results. The prevalence of anemia was substantially elevated in those who had two or three abnormal tests.[2, 5] The selection of threshold values for abnormal results were based on those derived for the previous NHANES (1976-80) by an expert panel,[2, 6] except where (1) evidence existed for changes in assay methods or in changes in other confounding factors like blood lead; and (2) an evaluation of the iron status indicator distribution in a reference group of healthy persons from the 1988-94 NHANES supported a change in the 1976-80 NHANES thresholds.[1]

Threshold values for abnormal results on iron tests vary by age. Abnormal values for serum ferritin concentration based on the BioRad assay are defined as less than 10 µg/L for children aged 1 to 4 years and less than 12 µg/L for females aged 12 to 49 years. These thresholds had to be adjusted for use with serum ferritin measured with the Roche assay in NHANES 2003-2006 using the following piecewise linear regression equations for serum ferritin less than 25 µg/L based on data from a cross-over study: Roche = 1.2534 x BioRad + 1.4683; the resulting adjusted thresholds were less than 14 µg/L for children aged 1 to 4 years and less than 16.5 µg/L for females aged 12–49 years.[7] Abnormal values for free erythrocyte protoporphyrin are greater than 1.42 µmol/L for children aged 1 to

2 years (80 µg/dL of red blood cells), and greater than 1.24 µmol/L (70 µg/dL of red blood cells) for other persons. Abnormal values for transferrin saturation are less than 10 percent for children aged 1 to 2 years, less than 12 percent for children aged 3 to 4 years, less than 14 percent for females aged 12 to 15 years, and less than 15 percent for females aged 16 years and older.

The terms anemia, iron deficiency, and iron deficiency anemia are often used interchangeably, but are not equivalent. Anemia can be caused by many factors other than iron deficiency, including other nutrient deficiencies, infection, inflammation, and hereditary anemias. When the prevalence of iron deficiency is high, such as during the third trimester of pregnancy, anemia is a good predictor of iron deficiency. When the prevalence of iron deficiency is low, such as among white, non-Hispanic children aged 3 to 4 years in the United States, the majority of anemia is due to other causes.

No comparable data source is available to measure iron deficiency at the State level. The Pediatric Nutrition Surveillance System is used to monitor the percent of anemia (low hemoglobin or hematocrit) among low-income children aged 1 to 4 years participating in public health programs.

Anemia is used for monitoring risk of iron deficiency at the State and local levels because of its cost and feasibility for use in the clinic setting. Changes in the prevalence of anemia over time at the State and local levels can be used to evaluate the effectiveness of programs to decrease the prevalence of iron deficiency.

This objective differs from Healthy People 2000 objective 2.10, which defined iron deficiency as abnormal results for two or more of the following tests: mean cell volume, free erythrocyte protoporphyrin, and transferrin saturation. For Healthy People 2010 objective 19-12, serum ferritin replaces mean cell volume in the definition of iron deficiency. Serum ferritin is a more sensitive measure of iron deficiency.[8]

For some measures, data do not meet the criteria for statistical reliability, data quality, or confidentiality and have been suppressed. Information on suppression of data for the major Healthy People 2010 data systems has been published in a *Healthy People Statistical Note.*[9]

See Part C for a description of NHANES and Appendix A for focus area contact information.

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