

ANTHROPOMETRIC MEASUREMENTS

RATIONALE

Anthropometrics are a set of non-invasive, quantitative body measurements used to assess growth, development, and health parameters. Anthropometric measurements, including length or height, weight, and head circumference, help providers determine if a child is growing properly and can indicate when the child's health and well-being are at risk. Additionally, anthropometric measurements assist providers in selecting appropriate treatment options for children and adolescents.

Two of the most important health indicators for children are their individual growth pattern and their weight for height relationship, which are determined by accurate serial anthropometric measurements. Abnormal linear growth or weight gain can indicate a variety of medical, psychological, or socio-economic problems and require additional assessment techniques beyond anthropometric measurements. Childhood and adolescent overweight and obesity have significant adverse effects on health as they can lead to type 2 diabetes, hypertension, dyslipidemia, pulmonary complications, musculoskeletal problems, and psychosocial problems which may affect the child or adolescent throughout life.¹ Inadequate weight gain may be a sign of malnutrition, inappropriate childrearing or an indication of a serious medical problem. Identifying underweight or malnutrition is important as "malnutrition not only jeopardizes the child's growth but also impairs immunocompetence and contributes to concurrent and long-term deficits in cognition and socioaffective competence".² For infants and toddlers, measuring head circumference for possible abnormal growth may help identify neurological abnormalities, malnutrition, or other health related concerns.

Accurate anthropometric measurements are paramount to providers adequately assessing the health of children and adolescents and in choosing appropriate treatments and interventions necessary to maintain or improve health. This section covers common anthropometric measurements used to assess a child's health during a routine well-child visit.

Fundamentals of Common Anthropometric Measures:

The following information regarding techniques for measuring head circumference, recumbent length, height, and weight has been adapted to meet CHDP minimal guidelines for measuring equipment and is available in its original form at [Accurately Weighing and Measuring Infants, Children and Adolescents](#).

- Head circumference – For children from birth to age two, measure the largest circumference of the head by extending a non-stretchable measuring tape around the most prominent part of the occiput to the middle of the forehead. Pull the tape snugly to compress the hair and underlying soft tissue. Read the measurement to the nearest 0.1 cm or 1/8 inch. Repeat the measurement twice or until two measurements agree within 0.2 cm or ¼ inch. Record the average of the two closest measurements.

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- Recumbent length – Measure children under 24 months and children 24 to 36 months who cannot stand lying down on an infant measuring board that has a fixed headboard and movable footboard. Remove any clothing that interferes with obtaining precise measurements such as shoes, booties, and bulky clothes before measuring the child. Two people are required to obtain this measurement. One person aligns the infant's head against the top of the headboard, and the other person straightens the infant's body and legs while keeping the infant's feet pointed upward and parallel to the footboard. Bring the footboard against the bottom of the feet. Read the measurement to the nearest .1 cm or 1/8 inch. Repeat the measurement twice or until two measurements agree within .2 cm or ¼ inch. Record the average of the two closest measurements.

- Height (stature) – Measure children aged two years and older who can stand using a standard measuring board with a moveable headboard (stadiometer) attached to a flat wall. Measure the child wearing light clothing and without shoes and/or heavy socks. Request the child look forward and stand-up straight with buttocks, shoulder blades and heels together touching the wall or stadiometer. Align the headboard perpendicular to the wall and lower headboard to the top of the child's head. Read the measurement to the nearest .1 cm or 1/8 inch. Repeat the measurement twice or until two measurements agree within 1 cm or ¼ inch. Record the average of the two closest measurements.

- Weight
 - Children < 2 years of age – Weigh the child without clothes or a diaper using a calibrated beam or digital infant scale. Position child in the center of the scale tray and read the measurement to the nearest 1-ounce or .1 kg. AAP recommends weighing infants to the nearest .01 kg or ½ ounce.
 - Children > 2 years of age – Weigh the child on a calibrated beam balanced floor scale or electronic floor scale with increments less than or equal to .1 kg or ¼ pound. Weigh young children without shoes and wearing underclothes only, unless privacy cannot be assured. For older children and young children when privacy is a concern, weigh the child wearing minimal indoor clothing and without shoes. Request child or adolescent stand in the center of the platform of the scale and remain motionless until the measurement can be obtained. Measure the weight to the nearest 0.1 kg or ¼ pound. AAP recommends children continue to be weighed to the nearest .01 kg or ½ ounce when using a digital scale.

- Body Mass Index (BMI) – BMI is a calculation based on the relationship of height to weight used to screen for adiposity in individuals 2 years and older. Calculating and tracking BMI for children 2 years and older can help identify risks for overweight and obesity or risks for underweight. Due to the long-term,

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adverse health consequences associated with pediatric obesity, the American Academy of Pediatrics and the American Academy of Family Physicians endorse the universal screening of BMI and use of BMI growth curves for plotting BMI percentiles to identify obese and overweight children. The [Body Mass Index \(BMI\)-for-Age Percentile Job Aid \(CHDP Provider Information Notice 08-02\)](#) provides information on calculating and plotting BMI.

- Z-scores – In 2013, the American Academy of Pediatrics endorsed the use of Z-scores to define underweight or malnutrition in children.³ A Z-score represents the number of standard deviations an observation or data point is above or below the population mean. Identifying malnutrition in children is critical for determining appropriate treatment options. Z-scores for the following may be used to determine malnutrition: weight-for-height (WFH), weight-for-age (WFA), BMI for age, and head circumference (HC). Levels of malnutrition based on BMI for age Z-scores are defined as follows: -1.0 to -1.9 is mild malnutrition, -2.0 to 2.9 is moderate malnutrition, and ≤ -3.0 is severe malnutrition. At this point, there is not a consensus on the use of Z-scores for classifying overweight and obesity.⁴ Z-scores are currently used in in-patient settings and are being implemented in many outpatient settings as well. The pediatric [BMI for age Z-score calculator](#) is available for calculating pediatric Z-scores.

Equipment for Measuring and Weighing:

Precise, reproducible measurements require well-calibrated, quality equipment that meets specific standards. The equipment used to obtain anthropometric measures must be checked regularly for proper functioning and accuracy. Well-maintained, approved equipment will result in fewer errors in measurements thus increasing the accuracy of the assessment and interpretation of growth patterns. At a minimum, the equipment used to obtain length, height, and weight measurements during CHDP health assessments must meet the criteria listed in the [“Equipment Guide for Measuring and Weighing”](#).

SCREENING REQUIREMENTS

- Serial measurements are the cornerstone for determining a child’s individual growth pattern and for identifying possible medical, nutrition, and growth-related problems. Therefore, it is imperative to measure length/height and weight using approved and calibrated equipment at each health assessment visit.
- Plot length or height and weight values on the appropriate growth charts according to the child’s age, sex, and birth weight. Use the [World Health Organization’s \(WHO\) growth charts](#) for infants and toddlers 0 to 2 years of age. For children 2 years and older, use the [Center for Disease Control and Prevention growth charts](#).
- Measure and plot head circumference for infants and toddlers to 2 years of age on WHO growth charts.

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- Calculate Body Mass Index (BMI) – For children 2 years and older, calculate and plot BMI on the appropriate growth chart for age and gender. Determine weight category and record on appropriate CHDP form:

Weight Category	Percentile Range
Underweight	Less than the 5 th percentile
Healthy Weight	5 th percentile to less than the 85 th percentile
Overweight	85 th percentile to less than the 95 th percentile
Obese	Equal or greater than the 95 th percentile

- Optional – Use of Z-scores to assess malnutrition status. For additional information regarding the use of Z-scores to assess pediatric malnutrition, refer to [Defining Pediatric Malnutrition: A Paradigm Shift Toward Etiology-Related Definitions](#).

Bright Futures*

The 2014 [Bright Futures/AAP Periodicity Schedule](#) recommends the following anthropometric measurements be obtained at every preventive health care visit to assist with assessing growth and health:

- Infants and toddlers <24 months of age: weight, length, head circumference, and weight/length plotted
- Children \geq 24 months of age and adolescents: weight, length and BMI calculated and plotted

Additional information regarding AAP's recommendations for growth assessment can be accessed at [Performing Preventive Services: A Bright Futures Handbook](#) in the [Physical Examination](#) section, Assessing Growth and Nutrition, pages 51-56.

CONSIDERATIONS FOR REFERRAL TREATMENT AND/OR FOLLOW-UP

Infants and Children less than 2 years of age:

- Abnormal Head Circumference
 - Evaluate infants and toddlers with abnormal head circumference measurements for possible malnutrition, neurological problems or other medical concerns and refer as indicated. Abnormal head growth is defined as a head circumference greater than two standard deviations above (> 98%) or below (< 2%) the mean for a given age, gender, and gestation.
- Short stature
 - Infants and toddlers with a length-for-age that is less than the 2nd percentile on the WHO Growth Charts are classified as having **short stature**. Further assessment is required when infants have inadequate linear growth velocity. Consider referral to a pediatric specialist when warranted.

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- Underweight
 - Infants and toddlers with a weight-for-length that is less than the 2nd percentile on the WHO Growth Charts are classified as **low weight-for-length**. Further assessment is required. Consider referral to a Women's, Infants and Children (WIC) Registered Dietitian, Lactation Consultant and/or pediatric specialist for additional assessment and follow-up.
- Inadequate weight gain
 - Infants and toddlers with inadequate weight gain for age (poor weight gain velocity) require additional assessment and should be monitored closely. Parents or guardians should be counseled on appropriate feeding practices for age. Consider referral to a Women's, Infants and Children (WIC) Registered Dietitian, Lactation Consultant and/or pediatric specialist for additional assessment and treatment.
- Overweight
 - Infants and toddlers with a weight-for-length that is higher than the 98th percentile are classified as **high weight-for-length**. Parents or guardians should be counseled on appropriate feeding practices for age. Consider referral to a Women's, Infants and Children (WIC) Registered Dietitian, Lactation Consultant and/or pediatric specialist for additional assessment and treatment.

Children greater than 2 years of age and Adolescents:

- Short Stature
 - Assess and monitor children and adolescents and counsel the appropriate family member or guardian when the following is noted:
 - The child falls below the 5th percentile on height-for-age growth charts
 - There is a significant decrease in linear velocity, such as passing downward through channels on the growth chart
 - Adequate linear velocity for age has not been achieved and familial short stature has been ruled out as the cause
- Underweight
 - Assess, counsel and monitor when BMI falls below the 5th percentile for age and sex or with unplanned weight loss.
- Overweight
 - Defined as a BMI percentile between the 85th and 94th percentile. Counsel and monitor children and adolescents in this category and refer to a registered dietitian. For additional guidance, refer to the [Expert Committee Recommendations on the Assessment, Prevention, and Treatment of Child and Adolescent Overweight and Obesity – 2007, An Implementation Guide from the Childhood Obesity Action Network](#).
- Obese

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- Defined as a BMI percentile at or above the 95th percentile. Counsel and monitor children and adolescents in this category and refer to a registered dietitian. For additional guidance, refer to the [Expert Committee Recommendations on the Assessment, Prevention, and Treatment of Child and Adolescent Overweight and Obesity – 2007, An Implementation Guide from the Childhood Obesity Action Network](#).

Arrange for further physical and laboratory examinations if information from the measurement and nutritional assessment suggests an eating disorder, dietary inadequacy, obesity or other nutritional problems.

Resources

- U.S. Department of Health and Human Services Health Resources and Services Administration Maternal and Child Health Bureau, [Accurately Weighing and Measuring Infants, Children and Adolescents](#): Technique
- Tanski S, Garfunkel LC. Assessing Growth and Nutrition. [Performing Preventive Services: A Bright Futures Handbook](#), pages 51-55:
- [CHDP Provider Information Notice No. 08-02, Body Mass Index \(BMI\)-For-Age Percentile Job Aid, 2008](#)
- [CHDP Equipment Guide for Measuring and Weighing](#)
- [World Health Organization \(WHO\) Growth Charts for infants and children 0 to 2 years of age](#)
- Centers for Disease Control and Prevention (CDC)/National Center for Health Statistics (NCHS) [Growth Charts for children ages 2 years and older](#)
- [Use and Interpretation of the WHO and CDC Growth Charts for Children from Birth to 20 Years in the United States](#)
- [How to Accurately Weigh and Measure Children for the CHDP Well-Child Exam](#), Adapted by the State of California CHDP Nutrition Subcommittee from the online training module: “Accurately Weighing & Measuring Infants, Children and Adolescents: Technique”, August 2012
- Barlow, SE, and Expert Committee. [Expert Committee Recommendations Regarding the Prevention, Assessment, and Treatment of Child and Adolescent Overweight and Obesity: Summary Report, Pediatrics.2007](#); 120 Suppl 4:S164-S192. Accessed August 18, 2014
- [CHDP Provider Information Notice No. 05-16, Addition of Fasting Blood Glucose and Cholesterol Screening Test as CHDP Benefits, Reporting Codes, and Reimbursement, 2005.](#)
- [Overview of the CDC Growth Charts](#)
- CHDP Online Training and Resource Material: [Childhood Obesity](#)
- CHDP Online Training and Resource Material: [Body Mass Index Training](#)

References

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1. Duncan P, Hagan JF, Shaw, JS. [Bright Futures: Guidelines for Health Supervision of Infants, Children and Adolescents](#). Elk Grove Village, IL; 2008.
2. Kleiman RE, Greer FR, eds. [American Academy of Pediatrics Committee on Nutrition. Assessment of Nutritional Status](#). Pediatric Nutrition. 7th ed. Elk Grove Village, IL: 2014.
3. American Academy of Pediatrics. [Statement of Endorsement: Defining Pediatric Malnutrition](#). Pediatrics. DOI: 10.1542/peds. 2013-1284.
4. Mehta, NM, Corkins, MR, Lyman, B., et al. [Defining Pediatric Malnutrition: A Paradigm Shift Toward Etiology-Related Definitions](#). JPEN J Parenter Enter Nutr. 2013; 37(4):460-481.

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