

# MODULE 1: Growth Assessment

## LEARNING OBJECTIVES

After completing this module, you will have the skills and resources to:

- Describe techniques to obtain accurate anthropometric data for children with special health care needs
- Identify tools used for growth assessment and understand the origin of these tools
- Describe the influence of special conditions on growth
- Use appropriate reference data and published information to interpret growth data

## RESOURCES

### Measurement Techniques

**Anthropometric Standardization Reference Manual.** Lohman TG, Roche AF, Martorell R, eds. *Anthropometric Standardization Reference Manual*. Champaign, Ill: Human Kinetics Books, 1988. ISBN 0-87322-331-4. This book describes many measurement techniques. It is out of print, however, copies are sometimes available through college and university bookstores. Several online retailers, including <http://alibris.com> and <http://bookfinder.com>, sometimes have this book in stock.

**CDC/MCHB Growth Chart Tutorials: Measurement Techniques.** Centers for Disease Control and Prevention and the Maternal and Child Health Bureau. *Growth Charts Training*. 2001. The CDC and MCHB have developed tutorials to accompany the 2000 CDC Growth Charts. These tutorials are aimed at health care professionals. Modules cover equipment, measurement technique, and developing and rating your technique. For information about accessing the tutorials, visit <http://depts.washington.edu/growth>.

### Tools for Assessment

**CDC Growth Charts.** Centers for Disease Control and Prevention (CDC). Information about the 2000 CDC Growth Charts, and downloadable versions of the charts are available on the CDC website: <http://www.cdc.gov/growthcharts>.

**The New Childhood Growth Charts.** Roberts B, Dallal GE. The new childhood growth charts. *Nutrition Reviews*. Volume 59, Number 2, pages 31-36. February



Nutrition for Children with Special Health Care Needs  
Resource Manual

<http://www.pacificwestmch.org>

2001. This article is posted to the PacWest MCH Distance Learning Network website, <http://depts.washington.edu/pwdlearn/pdfs/childcharts.pdf>, with permission from the International Life Science Institute.

**Frequently Used Guidelines: Anthropometrics and growth.** Guidelines for interpretation of growth are presented.

<http://depts.washington.edu/nutrpeds/fug/growthtoc.htm>.

**CDC/MCHB Growth Chart Tutorials: Growth Assessment.** Centers for Disease Control and Prevention and the Maternal and Child Health Bureau. *Growth Charts Training*. 2001. The CDC and MCHB have developed tutorials to accompany the 2000 CDC Growth Charts. These tutorials are aimed at health care professionals. Modules cover use and interpretation of the charts, including BMI. For information about accessing the tutorials, visit <http://depts.washington.edu/growth>.

**Other Growth Charts.** Charts with data for secondary measurements and alternatives to height and length are available.

- Crown-rump Length. Crown-rump length. McCammon RW, ed. *Human Growth and Development*. Springfield, Ill: Charles C Thomas, 1970. Longitudinal data from 75 females and 75 males are presented.
- Prediction of Stature from Knee Height. Chumlea WC, Guo SS, Steinbaugh ML. Prediction of stature from knee height for black and white adults and children with applications to mobility-impaired or handicapped persons. *J Am Diet Assoc*. 1994; 94(12): 1385-1388. This article presents data collected during 1960-1970 from children 6-12 years of age. The population was 85% Caucasian.
- Sitting Height. Hamill PV, et al. Body weight, stature and sitting height. *US Vital and Health Statistics, Series 11, #126*; Publication No. HSM 73-1606. Washington DC: US Government Printing Office, 1973. These tables (sitting height for age) are based on the NCHS 1977 population (age 1-18 years).
- Triceps Skinfold and Upper Arm Circumference. Frisancho AR. New norms of upper limb fat and muscle areas for assessment of nutritional status. *Am J Clin Nutr*. 34: 2540-2545, 1981. This article provides age- and sex-specific percentiles for triceps skinfold, upper arm circumference, arm muscle area, and arm fat area based on a cross-sectional sample of 19,097 white subjects age 1 to 74 years.

## **Influence of Special Health Care Needs**

### **Charts/Tables Used to Monitor Growth of Children with Special Health Care Needs.**

Reprinted with permission from: Nardella M, et al. *Nutrition Interventions for Children with Special Health Care Needs*. Washington State Department of Health. 2001. This table describes charts and tables that are often used to monitor the growth of children with special health care needs. It is included at the end of this section. To order a hard copy, contact the Washington State Department of Health, Revenue Section, PO Box 1099, Olympia, WA 98504 or visit the Washington State Nutrition for Children with Special Health Care Needs website: <http://depts.washington.edu/cshcnut>. This publication can also be downloaded from the WA DOH website:

<http://www.doh.wa.gov/cfh/mch/CSHCNhome2.htm>.

**Gaining and Growing.** The Gaining and Growing website presents information about the influence of prematurity on anthropometric assessment, including catch-up growth and incremental growth. Visit:

<http://staff.washington.edu/growing/Assess/index~3.htm>.

**North American Growth in Cerebral Palsy Project.** North American Growth in Cerebral Palsy Project website. One activity of this project is to collect data about the growth of persons with cerebral palsy. The project website also lists some resources around growth, measurement technique, and interpretation. Visit:

<http://www.people.virginia.edu/~mon-grow/>.

## **Using Growth Data to Make Clinical Decisions**

**Assessment of Growth: Equipment, techniques and growth charts.** Feucht S. Assessment of growth: Part 1, equipment, technique and growth charts.

*Nutrition Focus*. 15(2). 2000. To order, visit

[http://depts.washington.edu/chdd/ucedd/CO/co\\_NutriFocus.html](http://depts.washington.edu/chdd/ucedd/CO/co_NutriFocus.html).

**Assessment of Growth: Interpretation of growth.** Trahms C, Feucht S.

Assessment of growth: Part 2, interpretation of growth. *Nutrition Focus*. 15(3 and 4). 2000. This article presents case studies using the 2000 CDC Growth Charts to evaluate growth. To order, visit

[http://depts.washington.edu/chdd/ucedd/CO/co\\_NutriFocus.html](http://depts.washington.edu/chdd/ucedd/CO/co_NutriFocus.html).

**Anthropometrics.** Murphy K. Anthropometrics. In: Nardella M, et al. *Nutrition Interventions for Children with Special Health Care Needs*. Washington State Department of Health. 2001. This chapter describes techniques for weighing and measuring children and presents some guidelines for interpreting measurements. Ordering information is above. (See "Charts/Tables Used to Monitor Growth of Children with Special Health Care Needs.")

**Table 2-2: Charts/Tables Used to Monitor Growth of Children with Special Health Care Needs<sup>†</sup>**

Growth Chart	Study sample information	Ages	Parameters	Limitations	Use with CDC
NCHS (1977) <sup>17</sup>	20,000 children, 1934-64; NHES and NHANES I; 5 <sup>th</sup> -95 <sup>th</sup> %iles	0-3 years	<ul style="list-style-type: none"> <li>weight/age</li> <li>length/age</li> <li>OFC/age</li> <li>weight/length</li> </ul>	Data is longitudinal for infants and cross-sectional for children	
NCHS (1977) <sup>17</sup>	20,000 children 1934-64; NHES and NHANES I; 5 <sup>th</sup> -95 <sup>th</sup> %iles	2-18 years	<ul style="list-style-type: none"> <li>weight/age</li> <li>height/age</li> <li>weight/height</li> </ul>	Data is cross-sectional for children	
CDC (2000) <sup>1</sup>	Previous data plus NHANES III data; 3 <sup>rd</sup> -97 <sup>th</sup> %iles	0-3 years	<ul style="list-style-type: none"> <li>weight/age</li> <li>length/age</li> <li>OFC/age</li> <li>weight/length</li> </ul>		
CDC (2000) <sup>1</sup>	Previous data plus NHANES III data; 3 <sup>rd</sup> -97 <sup>th</sup> %iles	2-20 years	<ul style="list-style-type: none"> <li>weight/age</li> <li>height/age</li> <li>weight/height (2-6 years)</li> <li>BMI/age</li> </ul>		
Crown-rump <sup>18</sup>	~75 females, 75 males			Longitudinal data	Use with CDC weight/ age
Sitting height <sup>19</sup>	NCHS 1977 population	1-18 years	<ul style="list-style-type: none"> <li>sitting height/age</li> </ul>	Caucasian and African American children only	Use with CDC weight/ age
Knee height <sup>20</sup>	13,821 ambulatory children NHES I,II,III, 1960-70	6-12 years	<ul style="list-style-type: none"> <li>knee height/age</li> </ul>	Use equation for race (85% Caucasian children); Difficult to do	Use with CDC weight/ age
Incremental growth <sup>9</sup>	Children who grew "close" to NCHS 1977	6-36 mos 2-18 years	<ul style="list-style-type: none"> <li>weight/age</li> <li>stature/age</li> </ul>	Caucasian children only	Use with CDC for weight/age, length or height/age, weight/length or height

<sup>†</sup> All charts have sex-specific versions for male and female children (except for Turner syndrome charts).

Growth Chart	Study sample information	Ages	Parameters	Limitations	Use with CDC
Triceps skinfold thickness, upper arm circumference <sup>10</sup>	NCHS 1977 population	2-18 years	<ul style="list-style-type: none"> <li>triceps skinfold/age</li> <li>upper arm circumference/ age</li> <li>upper arm fat area/age</li> </ul>	Use after age 2 years, Caucasian children only	Use with CDC weight/age, length or height/age, weight/length or height, or BMI/age
Mid-arm circumference; triceps skinfold, subscapular skinfold thicknesses <sup>13,14,15</sup>	NCHS 1977 population	2-18 years		Use after age 2 years	Use with CDC weight/age, length or height/age, weight/length or height, or BMI/age
Parent-specific adjustment for length/stature <sup>11</sup>	586 parent-child pairs (Fels data) and 16,000 serial length and height measurements	0-36 mos 3-18 years		Note parent height on chart	Use with CDC weight/age, length or height/age, weight/length or height, or BMI/age
Achondroplasia <sup>22</sup>	189 males, 214 females	0-18 years	<ul style="list-style-type: none"> <li>height/age</li> <li>height velocity/age</li> <li>upper, lower segment lengths/age</li> <li>OFC/age</li> </ul>	Small sample size, especially children over 10 years	Compare to CDC weight/age, length or height/ age; use with CDC for weight/length or height or BMI/age
Cerebral palsy <sup>23</sup>	360 children (males and females), 0-120 months with quadriplegia	0-10 years	<ul style="list-style-type: none"> <li>length/age</li> <li>weight/age</li> <li>weight/length</li> </ul>	Both longitudinal and cross-sectional data, small sample size, for spastic quadriplegia only <sup>†</sup>	Use with CDC weight/age, length or height/age, weight/length or height or BMI/age
Down syndrome <sup>24</sup>	Longitudinal data; 400 males, 300 females; 1960-1986	1-36 mo 2-18 years	<ul style="list-style-type: none"> <li>weight/age</li> <li>length or height/age</li> </ul>	Included children with congenital heart disease, reflects tendency to be overweight	Use with CDC weight/age, length or height/ age, weight/length or height, or BMI/age

<sup>†</sup> These growth charts should be used only with children who have cerebral palsy with spastic quadriplegia and may underestimate the growth for a child with mild cerebral palsy or without spastic quadriplegia. More information about growth and children with cerebral palsy can be found at the North American Growth in Cerebral Palsy Project website: <http://www.people.virginia.edu/~mon-grow/healthcare/home.html>

Section 1 – Determination of Nutrition Status

<b>Growth Chart</b>	<b>Study sample information</b>	<b>Ages</b>	<b>Parameters</b>	<b>Limitations</b>	<b>Use with CDC</b>
Noonan syndrome <sup>25</sup>	64 males, 48 females	0-20 years	<ul style="list-style-type: none"> <li>height/age</li> </ul>	Small sample size	Compare to CDC; use CDC for weight/ age, length or height/age, weight/length or height or BMI/age
Prader Willi syndrome <sup>26</sup>	56 males, 36 females	3-24 years	<ul style="list-style-type: none"> <li>height/age</li> </ul>	Longitudinal and cross-sectional data, small sample size	Compare to CDC; use CDC for weight/ age, weight/ height, BMI/age
Turner syndrome <sup>27</sup>	366 females; pooled data; no hormone treatment	2-19 years	<ul style="list-style-type: none"> <li>height/age</li> </ul>	Small sample size, unequal age distribution	Use with CDC for weight/age, height/ age, weight/height, BMI/age
Williams syndrome <sup>28</sup>	61 females, 47 males	0 to 18 years	<ul style="list-style-type: none"> <li>weight/age</li> <li>height/age</li> <li>OFC/age</li> </ul>	Retrospective and cross-sectional data, small sample size	Use with CDC for weight/length or height, BMI/age

1. Kuczumski RJ, Ogden CL, Grummer-Strawn LM, et al. CDC growth charts: United States. *Advance Data from Vital and Health Statistics*; no. 314. Hyattsville Maryland: National Center for Health Statistics. 2000. Available at <http://www.cdc.gov/growthcharts/>. Accessed October 30, 2000.
9. Roche AF, Himes JH. Incremental growth charts. *Am J Clin Nutr*. 1980;33:2041-2052.
11. Himes JH, Roche AF, Thissen D, Moore WM. Parent-specific adjustments for evaluation of recumbent length and stature of children. *Pediatrics*. 1985;75(2): 304-313.
13. Frisancho AR. New norms of upper limb fat and muscle areas for assessment of nutritional status. *Am J Clin Nutr*. 1981;34:2540-2545.
14. Gurney JM, Jelliffe DB. Arm anthropometry in nutritional assessment: a nomogram for rapid calculation of muscle circumference and cross-sectional muscle and fat areas. *Am J Clin Nutr*. 1973; 26:912-915.
15. Tanner JM, Whitehouse RH. Revised standards for triceps and subscapular skinfolds in British children. *Arch Dis Child*. 1975;50:142-145.
17. Hamill PV, Drizd TA, Johnson CL, Reed RB, Roche AF, Moor WM. Physical growth: National Center for Health Statistics percentiles. *Am J Clin Nutr*. 1979;32(3):607-629.
18. McCammon RW, ed. *Human Growth and Development*. Springfield, IL: Charles C Thomas; 1970.
19. Hamill PV, et al. Body weight, stature, and sitting height. *US Vital and Health Statistics, Series 11, #126*; Publication No. HSM 73-1606. Washington DC: US Government Printing Office; 1973.
20. Chumlea WC, Guo SS, Steinbaugh ML. Prediction of stature from knee height for black and white adults and children with application to mobility-impaired or handicapped persons. *J Am Diet Assoc*, 1994; 94(12):1385-1388.
21. Johnson CL, et al. Basic data on anthropometric measurement and angular measurements of the hip and knee joints for selected age groups, 1-74 years of age, United States, 1971-1975. *US Vital and Health Statistics, Series 11, #219*; Publication No. PHS 81-1669. Washington DC: US Government Printing Office; 1981.
22. Horton WA, Rotter JI, Rimoin DL, Scott CI, Hall JG. Standard growth curves for achondroplasia. *J Pediatr*. 1978;93(3):435-438.
23. Krick J, Murphy-Miller P, Zeger S, Wright E. Pattern of growth in children with cerebral palsy. *J Am Diet Assoc*. 1996;96(7):680-685.
24. Cronk C, Crocker AC, Pueschel SM, Shea AM, Zackai E, Pickens G, Reed RB. Growth charts for children with Down syndrome: 1 month to 18 years of age. *Pediatrics*. 1988;81(1):102-110.
25. Witt DR, et al. Growth curves for height in Noonan syndrome. *Clin Genet*. 1986; 30:150-153.
26. Holm V. In: Greenswag LR, Alexander RC. *Management of Prader-Willi Syndrome, 2<sup>nd</sup> ed*. New York: Springer-Verlag; 1995.
27. Ranke MB, Pfluger H, Rosendahl W, Stubbe P, Enders H, Bierich JR, Majewski F. Turner syndrome: spontaneous growth in 150 cases and review of the literature. *Eur J Pediatr*. 1983;141(2):81-88.
28. Morris CA, Demsey SA, Leonard CO, Dilts C, Blackburn BL. Natural history of Williams syndrome: physical characteristics. *J Pediatr*. 1988;113(2):318-326.