PEDIATRIC PULMONARY CENTER

Tucson, Arizona

Pediatric Anthropometrics:
Proper Techniques for Measuring & Recording

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Table of Contents

Pre-Test

1. Plotting a child's growth at each visit with their health care team helps screen for nutrition related health problems, highlight important information about a child's growth pattern and

    A. Diagnose a child with a disease.

    B. Identify if a child is growing along a healthy percentile curve.

    C. Identify if a child is tall enough.

    D. Calculate a child's growth velocity.

2. The steps in weighing an infant include:

    A. Remove infant's clothing and be sure the diaper is clean and dry

    B. Center the infant on the scale tray

    C. Weigh the infant to the nearest 0.01 kilogram or ½ ounce

    D. All of the above

3. An accurate lengthboard for measuring an infant's length has a firm, flat horizontal surface with a measuring tape in 1 mm (0.1 cm) or 1/8 inch increments, an immovable headpiece at a right angle to the tape, and which of the following?

    A. An attached pencil to make marks on the exam table

    B. A smoothly moveable footpiece, perpendicular to the tape.

    C. A loose measuring tape to estimate the length of an infant that will not lay still

    D. Restraints to hold the infant firmly in place

4. Child or adolescent stature should be measured twice and measurements should agree within:

    A. 2 cm

    B. 0.5 cm

    C. 1 cm

    D. 0.75 cm

5. The first step in measuring head circumference is?

    A. Remove any braids, barrettes, or other hair decorations that will interfere with the measurement

    B. Give the infant a toy to distract them from what you are doing

    C. Make sure they have on a clean diaper

    D. Place infant in highchair to keep them from moving around

6. Kathy's weight is 60.2 kilograms and her height is 160 centimeters. What is her BMI?

    A. 24.2

    B. 20.8

    C. 23.9

    D. 23.5

Introduction

What are Growth Charts?

Growth charts are clinical assessment tools that allow pediatric health professionals to track the growth (height/length, weight, head circumference, BMI) of U.S. children from infancy through adolescence.

What are Anthropometrics?

Anthropometrics are physical measurements like height, weight, length, and head circumference. Once measured these values are plotted on the appropriate growth chart.

Why are Growth Charts Important?

Plotting a child's growth at each visit with their health care team helps:
1. Screen for nutrition related health problems.
2. Highlight important information about a child's growth pattern.
3. Identify if a child is growing along a healthy percentile curve.

> **KEY: An accurate clinical assessment can assist in identifying nutrition-related health problems early so the necessary steps to treat or correct these problems can begin.**

Which Growth Chart should I use?

If the patient is lying down (aged birth to 3 years old) use:

- Length-for-age

- Weight-for-age

- Head circumference-for-age

- Weight-for-length

If the patient is standing up (aged 2 to 20 years old) use:

- Weight-for-age

- Stature-for-age

- BMI-for-age

Adapted from CDC.org

About this Self Study Manual

This self-study manual instructs health care providers on how to:

1. Accurately measure anthropometrics (height, weight, length, head circumference)

2. Calculate body mass index (BMI)

3. Plot anthropometric measurement and BMI values on the appropriate growth chart.

Time Frame: 30 minutes

Measuring Weight

TOOLS & EQUIPMENT

Scales for Weighing: Only use scales that have been accurately calibrated. Check with your supervisor to make sure scales are ready to use.

Infant Scale　　　　　　Child and Adolescent Scale

Illustration © Nardella, M, Campo, L, Ogata, B, eds. Nutrition Interventions for Children with Special Health Care

PROCEDURES

Infants
1. Remove excess clothing and be sure the diaper is clean and dry
2. Center the infant on the scale tray
3. Weigh infant to nearest 0.01 kg or 1/2 oz

> **Tip: For the best results, two people should work together to weigh the infant. One person weighs, protects the infant from harm; falling, etc., and reads the weight. The other immediately writes down the measurement.**

Alternative Approach - For use if an electronic scale is available.
1. Have the parent stand on the scale
2. Reset (tare) the scale to zero
3. Have the parent hold the infant
4. Read the infant's weight

> **Key: Remember that many adult scales generally only weigh to the nearest 100 gm.**

Children and Adolescents
1. Have patient remove shoes, jackets, or any extra clothing, and empty pockets
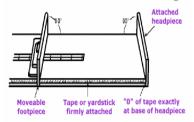2. Record the patient's weight to the nearest 0.01 kg or 1/2 oz
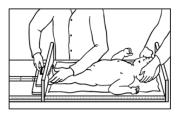
> ### Don't Forget!
>
> 1. **Repeat weight measurement!**
> 2. **Measurements should agree within** *0.01 kg for infants*
> *0.1 kg for children or adolescents*

Measuring Height & Length

TOOLS & EQUIPMENT
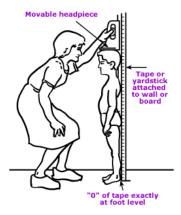
Infants-Lengthboard   Children and Adolescent-stadiometer

Illustrations © Nardella, M, Campo, L, Ogata, B, eds. Nutrition Interventions for Children with Special Health Care Needs, Olympia, WA, State Department of Health, 2001.

> * **<u>Do not</u> measure between two pencil marks on an exam table; it may measure 'short'.**
> * **Use an accurate lengthboard with a firm, flat horizontal surface with a measuring tape in 1 mm (0.1 cm) or inch increments, an immovable headpiece at a right angle to the tape, and a smoothly moveable footpiece, perpendicular to the tape.**

PROCEDURES

Infants <24 months old or 24 to 36 months unable to stand on own

1. Remove any hair ornaments or hats and shoes.
2. Lay child on their back in the center of the infant length board, shoulders and buttocks flat against the measuring surface, both legs fully extended, and feet flat against the footpiece.
3. Gently cup the infant's ears with the infant looking straight ahead in the *Frankfort Horizontal Plane* and the top of their head touching the headpiece. Make sure the infant's chin is not tucked in against his chest or stretched too far back.
4. Align the infant's body and place one hand on the infant's knees to fully extend <u>both </u>legs and bring the footpiece firmly against the heels.
5. **<u>REPEAT measurement – measurements should agree within 1 cm or ¼ inch!</u>**

> **Tip: For accurate length use two people.**

> **Frankfort Horizontal Plane: opening of ear and eye socket are horizontal to each other**

Children and Adolescents

1. Use a calibrated, vertical stadiometer with a movable headpiece, perpendicular to the vertical backboard to obtain an accurate measurement of stature.
2. Have patient remove shoes, any hair clips or hats, and release hair from bun or ponytail so it lies flat on top of the head.
3. Measure the patient standing on the footplate with heels, buttocks, shoulders and head touching a flat upright surface.
4. Patient should look straightforward with eyes parallel with the headpiece (Frankfort Horizontal Plane – see above)
   - ☐ Heels close together
   - ☐ Legs straight
   - ☐ Arms at sides
   - ☐ Shoulders relaxed
5. Lower the perpendicular headpiece snugly to the top of the head with sufficient pressure to compress the hair.
6. Record the height within 1 cm or ¼ inch.
7. **<u>REPEAT measurement – measurements should agree within 1 cm or ¼ inch!</u>**

Measuring Head Circumference

TOOLS & EQUIPMENT

Tape for Accurately Measuring Infant Head Circumference: Use a non-stretchable, ¼ - ½ inch wide, plasticized measuring tape (ideally an 'insertion tape'), with 0.1 cm increments.

USE:

❑ Non-stretchable, plasticized

❑ 1/4 - 1/2 inch wide

❑ Insertion tape

PROCEDURES

1. Remove any braids, barrettes, or other hair decorations that will interfere with the measurement
2. Position the tape just above the eyebrows, above the ears, and around the biggest part of the back of the head (occipital). The goal is to locate the maximum circumference of the head.
3. Pull the tape snugly to compress the hair and underlying soft tissues.
4. Read the measurement to the nearest 0.1 cm or 1/8 inch and recorded on the chart.

NOTE: The infant or child may be more comfortable in the arms or on the lap of a parent.

Don't Forget!
1. **Repeat measurement!**
2. **Measurements should agree within** *0.2 cm or ¼ inch*

Plotting on Growth Charts

TOOLS & EQUIPMENT

Growth chart: see Appendix for appropriate Growth Chart

PROCEDURE

1. **Calculate the infant appropriate age**:

   NOTE: A premature infant needs a gestation-adjusted age that is calculated by:

   i.   Record infant's gestational age in weeks. [i.e. from ultrasound]
   ii. Subtract the child's gestational age in weeks from 40 weeks (gestational age of term infant). This equals an adjustment for prematurity in weeks.
   iii. Subtract the adjustment for prematurity in weeks from the child's post-natal age in weeks. This equals the child's gestation-adjusted age.

   EXAMPLE

   An male infant was born prematurely on March 19, 2001. Based on ultrasound his gestational age at birth was determined to be 30 weeks. At the time of the June 11, 2001, clinic visit, his postnatal age is 12 weeks. What is his gestation-adjusted age?

   Step 1: 30 = gestational age in weeks
   Step 2: 40 - 30 = 10 weeks adjustment for prematurity
   Step 3: 12 - 10 = 2 weeks gestation-adjusted age

   KEY: The anthropometric measurements for this infant would be plotted on the growth chart for a 2 week old infant.

   adapted from CDC.org

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2. **Select Appropriate Growth Chart**

   If lying down use:
   - Length-for-age
   - Weight-for-age
   - Head circumference-for-age
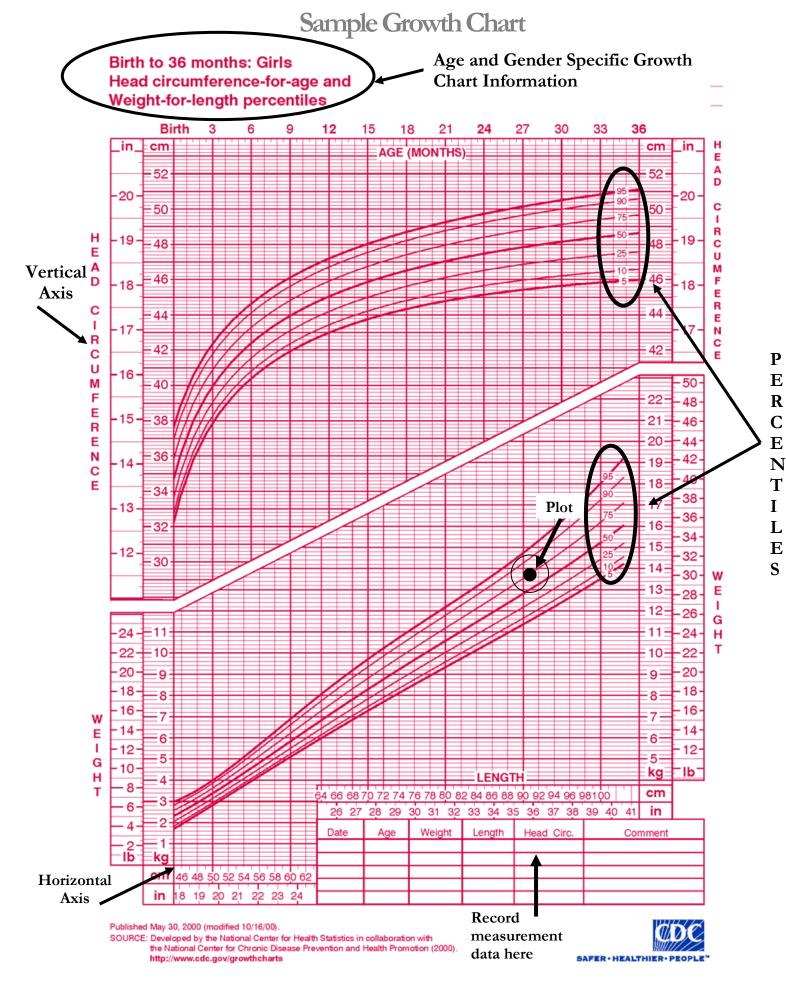   - Weight-for-length

   If standing up use:
   - Weight-for-age
   - Stature-for-age
   - BMI-for-age

   adapted from CDC.org

3. **Plot recorded measurement on the appropriate growth chart plot the measurements recorded in the data entry table for the current visit.**

   a) Find the child's age on the horizontal axis.

      - When plotting weight-for-length, find the length on the horizontal axis.
      - Use a straight edge or right-angle ruler to draw a vertical line up from this point.

   b) Find the appropriate measurement (weight, length, stature, head circumference, or BMI) on the vertical axis.

      - Use a straight edge or right-angle ruler to lightly draw a horizontal line across from that point until it intersects the vertical line.

   c) Make a small dot where the two lines intersect and circle this dot. This is your growth plot.

Sample Growth Chart

Birth to 36 months: Girls
Head circumference-for-age and
Weight-for-length percentiles

Age and Gender Specific Growth Chart Information

Vertical Axis

HEAD CIRCUMFERENCE

AGE (MONTHS)

Birth 3 6 9 12 15 18 21 24 27 30 33 36

in cm — cm in

HEAD CIRCUMFERENCE

95
90
75
50
25
10
5

PERCENTILES

Plot

95
90
75
50
25
10
5

WEIGHT

Horizontal Axis

46 48 50 52 54 56 58 60 62 cm
18 19 20 21 22 23 24 in

LENGTH

64 66 68 70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 100 cm
26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 in

Date	Age	Weight	Length	Head Circ.	Comment

Record measurement data here

Published May 30, 2000 (modified 10/16/00).
SOURCE: Developed by the National Center for Health Statistics in collaboration with
the National Center for Chronic Disease Prevention and Health Promotion (2000).
http://www.cdc.gov/growthcharts

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Measuring BMI

$$BMI = weight\ (kg)/height\ (m)^2$$

What is BMI?

Body mass index (BMI) is defined as <u>body weight in kilograms divided by height in meters squared</u> (Keys et al., 1972). BMI is an indirect measure of body fatness. It can be used as a screening tool to help identify if a child's weight-for-stature measurement reflects healthy, under or overweight in comparison to other children their age and gender.

> **NOTE: BMI has its limitations and if a child is identified as overweight per the BMI –for-age growth chart, additional assessments (skin folds, diet, health, physical activity) should also be made.**

TOOLS & EQUIPMENT

Calculator

PROCEDURE

1. Obtain height and weight measurements.
2. Select units for calculation. Kilograms or pounds for weight and meters or inches for height. Typically metric measurements are used (kilograms and meters); however, there is an equation for calculating BMI with pounds and inches.
3. Divide weight by height squared. (see example below)

Sample BMI Equations
BMI = Weight (kg) ÷ Stature (cm) ÷ Stature (cm) x 10,000
BMI = Weight (lb) ÷ Stature (in) ÷ Stature (in) x 703

Unit Conversions
Kilograms to pounds = Pounds/2.2   **Inches to Centimeters = Inches x 2.54**   **Centimeters to Meters = Centimeters / 100**

> In addition to using the correct units for weight and height (based on the equation you use for calculation), be careful to convert all ounces and fractions to the appropriate decimal place.

Converting Ounces and Fractions to Decimals

• **Weight of 37 pounds and 4 ounces (oz) = 37.25 pounds**
     (16 ounces = 1 pound, so 4 oz/16 oz = 0.25 pounds)
 • **Height of 41 and ½ inches = 41.5 inches**
     (1/2 inch = 0.5 inch)

Helpful Tool

Fraction = Ounce = Decimal
1/8 = 2 = 0.125
1/4 = 4 = 0.25
3/8 = 6 = 0.375
½ = 8 = 0.5
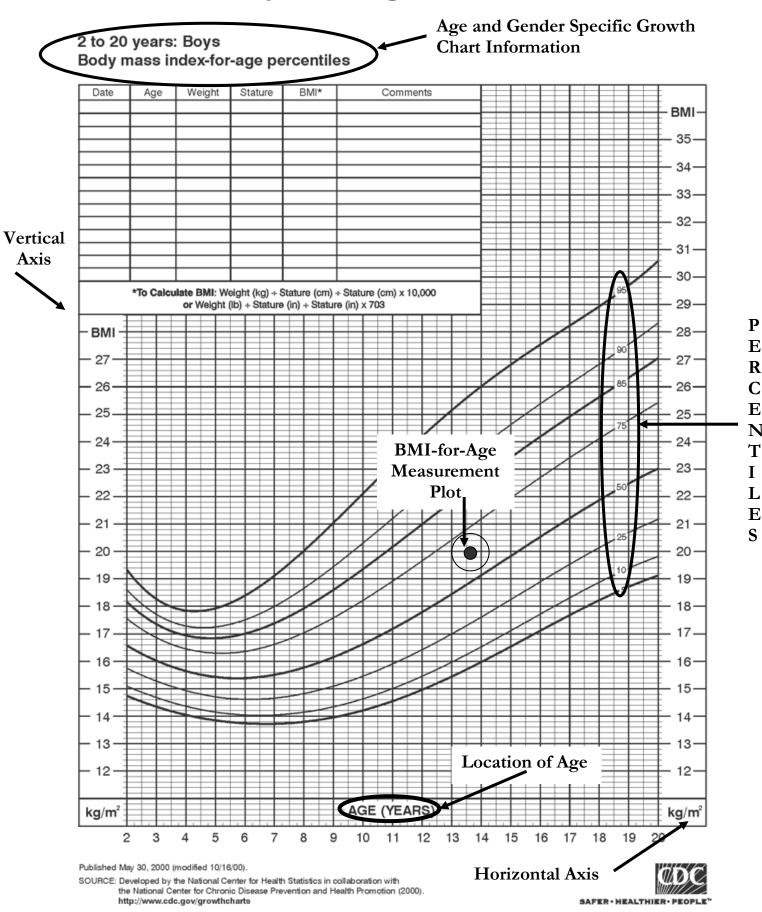5/8 = 10 = 0.625
¾ = 12 = 0.75
7/8 = 14 = 0.875

Plotting BMI

TOOLS & EQUIPMENT

Growth chart: see Appendix for appropriate Growth Chart

PROCEDURE

1. Collect weight and height measurements for the child following the guidelines outlined on pages 1 and 2.

2. Choose the BMI-for-Age growth chart that fits the child you are measuring based on their gender.

3. Calculate BMI using the equation that is appropriate for the units of your weight and height measurements.

4. Plot the BMI measurement on the BMI-for-Age growth chart.
   a. Find the child's age on the horizontal axis.
   b. Visually draw a vertical line up from this point.
   c. Find the child's BMI (number value) on the chart.
   d. Visually draw a horizontal line across from this BMI point towards the left vertical axis.

5. Plot where your two "visualized" lines meet with a small dot and circle the dot (plot). This equals the child's BMI-for-Age.
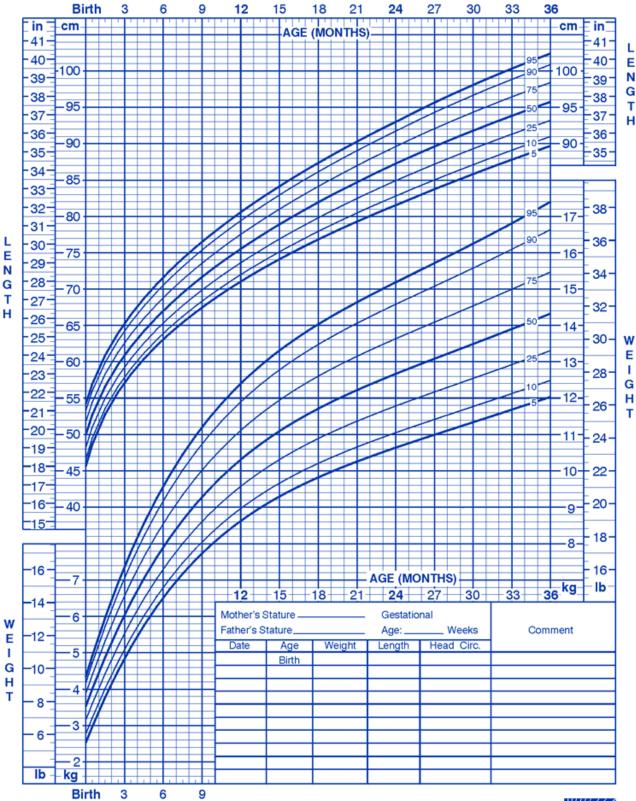
Example BMI-for-Age Growth Chart

Age and Gender Specific Growth Chart Information

2 to 20 years: Boys
Body mass index-for-age percentiles

Vertical Axis

PERCENTILES

Date	Age	Weight	Stature	BMI*	Comments

*To Calculate BMI: Weight (kg) ÷ Stature (cm) ÷ Stature (cm) x 10,000
or Weight (lb) ÷ Stature (in) ÷ Stature (in) x 703

BMI

- BMI
- 35
- 34
- 33
- 32
- 31
- 30
- 29
- 28
- 27
- 26
- 25
- 24
- 23
- 22
- 21
- 20
- 19
- 18
- 17
- 16
- 15
- 14
- 13
- 12

95
90
85
75
50
25
10

BMI-for-Age Measurement Plot

Location of Age

AGE (YEARS)

kg/m² ... kg/m²

2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

Horizontal Axis

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References

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    http://www.cdc.gov/nchs/about/major/nhanes/growthcharts/background.htm. Accessed on March 26, 2003.

2. Centers for Disease Control. Use and Interpretation of the CDC Growth Charts. Available at:

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3. Centers for Disease Control. Growth Charts: Interactive Training Modules. Available at:

    http://www.cdc.gov/nccdphp/dnpa/growthcharts/training/modules/index.htm. Accessed on March 26, 2003.

4. Keys A, Fidanza F, Karvonen MJ, Kimura N, Taylor HL. Indices of relative weight and obesity. Journal of Chronic Disease 1972; 25:329-343.

5. World Health Organization. Physical Status: The Use and Interpretation of Anthropometry. Geneva:

6. Himes JH, Dietz WH. Guidelines for overweight in adolescent preventive services: Recommendations from an expert committee. American Journal of Clinical Nutrition 1994;59:307–316

Post-Test

1. Plotting a child's growth at each visit with their health care team helps screen for nutrition related health problems, highlight important information about a child's growth pattern and

    A. Diagnose a child with a disease.

    B. Identify if a child is growing along a healthy percentile curve.

    C. Identify if a child is tall enough.

    D. Calculate a child's growth velocity.

2. The steps in weighing an infant include:

    A. Remove infant's clothing and be sure the diaper is clean and dry

    B. Center the infant on the scale tray

    C. Weigh the infant to the nearest 0.01 kilogram or ½ ounce

    D. All of the above

3. An accurate lengthboard for measuring an infant's length has a firm, flat horizontal surface with a measuring tape in 1 mm (0.1 cm) or 1/8 inch increments, an immovable headpiece at a right angle to the tape, and which of the following?

    A. An attached pencil to make marks on the exam table

    B. A smoothly moveable footpiece, perpendicular to the tape.

    C. A loose measuring tape to estimate the length of an infant that will not lay still

    D. Restraints to hold the infant firmly in place

4. Child or adolescent stature should be measured twice and measurements should agree within:

    A. 2 cm

    B. 0.5 cm

    C. 1 cm

    D. 0.75 cm

5. The first step in measuring head circumference is?

    A. Remove any braids, barrettes, or other hair decorations that will interfere with the measurement

    B. Give the infant a toy to distract them from what you are doing

    C. Make sure they have on a clean diaper

    D. Place infant in highchair to keep them from moving around

6. Kathy's weight is 60.2 kilograms and her height is 160 centimeters. What is her BMI?

    A. 24.2

    B. 20.8

    C. 23.9

    D. 23.5

APPENDIX:

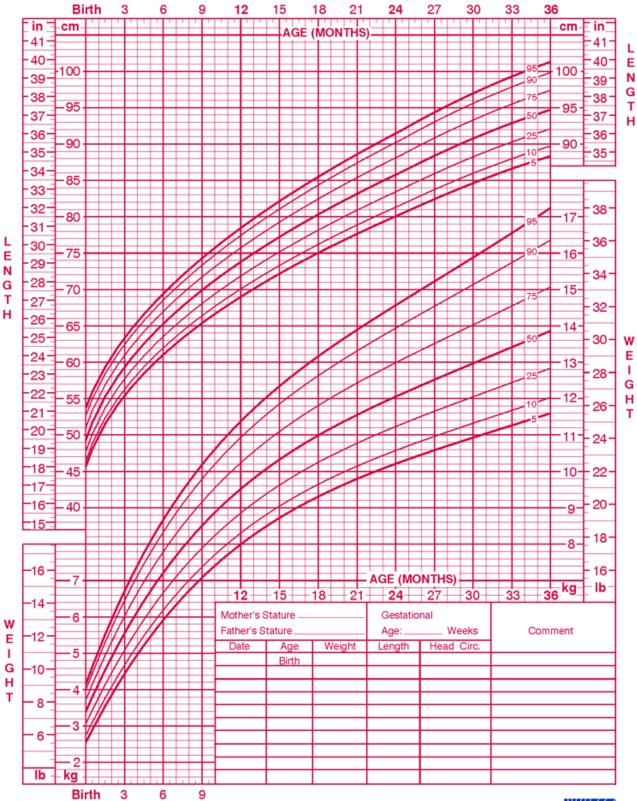# GROWTH CHARTS

Birth to 36 months: Boys
Length-for-age and Weight-for-age percentiles

NAME _____

RECORD # _____

AGE (MONTHS)

Birth 3 6 9 12 15 18 21 24 27 30 33 36

LENGTH

WEIGHT

Mother's Stature _____		Gestational			
Father's Stature _____		Age: _____ Weeks		Comment	
Date	Age	Weight	Length	Head Circ.	
	Birth				

Published May 30, 2000 (modified 4/20/01).
SOURCE: Developed by the National Center for Health Statistics in collaboration with
the National Center for Chronic Disease Prevention and Health Promotion (2000).
http://www.cdc.gov/growthcharts

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Birth to 36 months: Girls
Length-for-age and Weight-for-age percentiles

NAME _____

RECORD # _____

AGE (MONTHS) — Birth, 3, 6, 9, 12, 15, 18, 21, 24, 27, 30, 33, 36

LENGTH (in / cm) and WEIGHT (lb / kg) percentile curves: 95, 90, 75, 50, 25, 10, 5

Mother's Stature _____	Gestational	
Father's Stature _____	Age: _____ Weeks	Comment

Date	Age	Weight	Length	Head Circ.	
	Birth				

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Birth to 36 months: Boys
Head circumference-for-age and
Weight-for-length percentiles

NAME _____

RECORD # _____

AGE (MONTHS)

Birth 3 6 9 12 15 18 21 24 27 30 33 36

HEAD CIRCUMFERENCE

95
90
75
50
25
10
5

WEIGHT

LENGTH

Date	Age	Weight	Length	Head Circ.	Comment

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Birth to 36 months: Girls
Head circumference-for-age and
Weight-for-length percentiles

NAME _____

RECORD # _____

AGE (MONTHS)

Birth 3 6 9 12 15 18 21 24 27 30 33 36

HEAD CIRCUMFERENCE

WEIGHT

LENGTH

Date	Age	Weight	Length	Head Circ.	Comment

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2 to 20 years: Boys
Stature-for-age and Weight-for-age percentiles

NAME _____

RECORD # _____

Mother's Stature _____ Father's Stature _____

Date	Age	Weight	Stature	BMI*

*To Calculate BMI: Weight (kg) ÷ Stature (cm) ÷ Stature (cm) x 10,000
or Weight (lb) ÷ Stature (in) ÷ Stature (in) x 703

AGE (YEARS)

STATURE

WEIGHT

lb   kg

kg   lb

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2 to 20 years: Girls
Stature-for-age and Weight-for-age percentiles

NAME _____

RECORD # _____

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2 to 20 years: Boys
Body mass index-for-age percentiles

NAME _____

RECORD # _____

Date	Age	Weight	Stature	BMI*	Comments

*To Calculate BMI: Weight (kg) ÷ Stature (cm) ÷ Stature (cm) x 10,000
or Weight (lb) ÷ Stature (in) ÷ Stature (in) x 703

BMI

35
34
33
32
31
30
29
28
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
12

BMI

27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
12

95
90
85
75
50
25
10
5

kg/m²

AGE (YEARS)

kg/m²

2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

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2 to 20 years: Girls
Body mass index-for-age percentiles

NAME _____

RECORD # _____

Date	Age	Weight	Stature	BMI*	Comments

*To Calculate BMI: Weight (kg) ÷ Stature (cm) ÷ Stature (cm) x 10,000
or Weight (lb) ÷ Stature (in) ÷ Stature (in) x 703

AGE (YEARS)

BMI — 35 34 33 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 kg/m²

Percentile curves: 95, 90, 85, 75, 50, 25, 10, 5

Weight-for-stature percentiles: Boys

Date	Age	Weight	Stature	Comments

STATURE

cm: 80 85 90 95 100 105 110 115 120

in: 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47

Percentile curves labeled: 95, 90, 85, 75, 50, 25, 10, 5

kg / lb axes: 8–34 kg, 20–76 lb

Weight-for-stature percentiles: Girls

Date	Age	Weight	Stature	Comments

STATURE

cm 80 85 90 95 100 105 110 115 120

in 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47

Percentile curves labeled: 95, 90, 85, 75, 50, 25, 10, 5

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