Assessing Child Growth Using Body Mass Index (BMI)-for-Age Growth Charts
Training Objectives

By the end of this presentation, you will be able to:

• Select appropriate growth chart for age group
• Identify the age range for which Body Mass Index (BMI) screening is used
• Calculate or determine BMI value
• Plot BMI value on the appropriate growth chart
• Determine BMI-for-age percentile
• Identify weight category
• Record results on PM 160
Which Growth Chart Should I Use?

- **Birth to 2?**  Use WHO

- **2 to 20?**  Use CDC
What Is Body Mass Index?

- A number calculated using weight and height measurements:
  \[ \text{Body Mass Index (BMI)} = \frac{\text{Weight (kg)}}{\text{Height (m)}^2} \]
- It compares a person’s weight to height
- It is an indirect \textit{screening test} for body fatness
Why Use BMI-for-Age?

- Lifetime tracking tool
  - from age 2 through adult

- Relates weight, stature and age

- Screening for health and nutrition status required by CHDP and health plans

- Early indicator of other health risk factors
  - Hyperlipidemia
  - Elevated insulin
  - High blood pressure
**Body Mass Index Cutoff Values for Adults**

- Standard weight categories
- Same for all ages 18 +
- Same for men and women

<table>
<thead>
<tr>
<th>Weight Status</th>
<th>BMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obese</td>
<td>30.0 and above</td>
</tr>
<tr>
<td>Overweight</td>
<td>25.0 - 29.9</td>
</tr>
<tr>
<td>Normal</td>
<td>18.5 - 24.9</td>
</tr>
<tr>
<td>Underweight</td>
<td>Below 18.5</td>
</tr>
</tbody>
</table>
For Children, BMI Changes with Age

Example: Child’s growth tracking along 95th percentile

<table>
<thead>
<tr>
<th>Age</th>
<th>2</th>
<th>4</th>
<th>9</th>
<th>13</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI Value</td>
<td>19.3</td>
<td>17.8</td>
<td>21.0</td>
<td>25.1</td>
</tr>
</tbody>
</table>
BMI for Children and Teens

- Age- and sex-specific
- Plot BMI to find percentile
- Determine weight status

<table>
<thead>
<tr>
<th>Weight Status Category</th>
<th>Percentile Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obese</td>
<td>≥ 95th percentile</td>
</tr>
<tr>
<td>Overweight</td>
<td>85th to &lt; 95th percentile</td>
</tr>
<tr>
<td>Normal</td>
<td>5th to &lt; 85th percentile</td>
</tr>
<tr>
<td>Underweight</td>
<td>&lt; 5th percentile</td>
</tr>
</tbody>
</table>
What is a Percentile?

Major Percentile Divisions

<table>
<thead>
<tr>
<th>Percentile</th>
<th>CA CHDP 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>5th</td>
<td>19%</td>
</tr>
<tr>
<td>50th</td>
<td></td>
</tr>
<tr>
<td>85th</td>
<td>23%</td>
</tr>
<tr>
<td>95th</td>
<td></td>
</tr>
</tbody>
</table>
CDC Growth Charts

Tip: Download and print from www.cdc.gov/growthcharts/

Formula to calculate BMI

Percentile lines
5th - 10th - 25th - 50th
75th - 85th - 90th - 95th

Published May 30, 2000
(modified 2000-2001)
How to Read and Interpret the Growth Chart

- A single point on the curve indicates current status
- A series of BMI plots are needed to determine the growth trend
- If growth deviates from the expected growth pattern, further assessment may be needed
Adiposity Rebound

A normal increase in BMI after it reaches its lowest point, usually between ages 4 and 6.

- Child following 50th percentile curve
- Child following 10th percentile curve
- Child following 85th percentile curve
Early Adiposity Rebound

- An increase in BMI before age 5 is called *early adiposity rebound*.
- An upward BMI trend before age 5 is related to higher BMI in adulthood.
- This is a red flag indicating need for further nutrition and physical activity assessment.
Early Adiposity Rebound

Without Intervention

With Intervention
Excessive Adiposity Rebound

- Excessive adiposity rebound is also related to higher BMI in adulthood.
- Increasing BMI percentiles that cross major percentile lines are red flags indicating need for further nutrition and physical activity assessment.
Steps to Plot BMI-for-age

1. Select appropriate growth chart
2. Measure standing height accurately
3. Measure weight accurately
4. Determine BMI value
5. Determine BMI-for-age percentile
6. Record BMI percentile on PM 160
7. Determine weight category
Chart Carlos Correctly

Step 1:
Select Appropriate Growth Chart

- CDC 2 to 20 years: Boys
  - Stature-for-age
  - Weight-for-age
  - BMI-for-age
Step 2: Measure Standing Height

Record on growth chart and PM 160

<table>
<thead>
<tr>
<th>Date</th>
<th>Age</th>
<th>Weight</th>
<th>Stature</th>
<th>BMI*</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>32 #</td>
<td>38 ½&quot;</td>
<td></td>
<td>15.2</td>
</tr>
<tr>
<td>4</td>
<td>36 #</td>
<td>41 &quot;</td>
<td></td>
<td>15.0</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>45 3/4&quot;</td>
<td></td>
<td>15.0</td>
</tr>
</tbody>
</table>
Step 3: Measure Weight

Record on growth chart and PM 160

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<td>4</td>
<td>36 #</td>
<td>41 &quot;</td>
<td></td>
<td>15.0</td>
</tr>
<tr>
<td>6</td>
<td>43 ½ #</td>
<td>45 ¾&quot;</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Step 4A: Determine BMI Value

Method 1: Using a calculator

- English measurements
  \[ \text{Wt (pounds)} \div \text{Ht (inches)} \div \text{Ht (inches)} \times 703 \]
- Metric measurements
  \[ \text{Wt (kg)} \div \text{Ht (cm)} \div \text{Ht (cm)} \times 10,000 \]

TIP: Formulas are listed on the BMI-for-age chart
Step 4A: Determine BMI Value

Method 2: Using a BMI calculation wheel

- Line up the **height** on inner wheel with the **weight** on outer wheel
- Read BMI value in the window on the inner wheel
  
**Read number and decimal points from right to left!**
Step 4A: Determine BMI Value

Method 3: Using an online calculator or electronic health record

- CDC BMI Calculator for Child and Teen

- Children’s Hospital of Philadelphia Body Mass Index and Z-Score Calculation in Children
  http://stokes.chop.edu/web/zscore/

- Your clinic’s electronic health record system
Step 4A: Determine BMI Value

Method 3: Using an online calculator or electronic health record

Enter Data

BMI Calculator for Child and Teen

Birth Date:
July 1 2007

Date of Measurement:
July 1 2013

Sex:
♀ ○ ♂
boy ♀ girl ♂

Height, to nearest 1/8 inch:
3 feet, 9 inches, 3/4 fractions of an inch
(12 inches = 1 foot; Example: 4 feet, 5 1/2 inches)

Weight, to nearest 1/4 (.25) pound:
43 pounds, 1/2 fractions of a pound
(8 ounces = 1/2 pounds; Example: 75 3/4 pounds)

Calculate

View Results

BMI Calculator for Child and Teen

Information Entered
Age: 6 years 0 months
Birth Date: July 01, 2007
Date of Measurement: July 01, 2013
Sex: Boy
Height: 3 feet 9 3/4 inch(es)
Weight: 43-1/2 pounds

Results
Based on the height and weight entered, the BMI is 14.6, placing the BMI-for-age at the 24th percentile for boys aged 6 years 0 months. This child has a healthy weight.

- What does this mean?
- What should you do?
Step 4B: Determine BMI Value
Record on growth chart

<table>
<thead>
<tr>
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</tr>
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<td></td>
</tr>
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<td>36</td>
<td>41</td>
<td>15.0</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>43 ½</td>
<td>45 ¾</td>
<td>14.6</td>
<td></td>
</tr>
</tbody>
</table>
Step 5: Determine BMI-for-Age %ile

**TIP:** Use a transparent growth chart plotting aid

- Find age on horizontal axis
- Find BMI value on vertical axis
- Mark point of intersection
- Estimate BMI percentile
Step 6:
Record BMI Percentile on PM 160

- Estimate a whole number between 1 and 99 that best represents the percentile point plotted on the growth chart
### Step 7A: Determine Weight Category

Determined by certified CHDP health care provider (MD, NP, or PA)

<table>
<thead>
<tr>
<th>Weight Status Category</th>
<th>Percentile Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obese</td>
<td>$\geq 95^{th}$ percentile</td>
</tr>
<tr>
<td>Overweight</td>
<td>$85^{th}$ to $&lt; 95^{th}$ percentile</td>
</tr>
<tr>
<td>Normal</td>
<td>$5^{th}$ to $&lt; 85^{th}$ percentile</td>
</tr>
<tr>
<td>Underweight</td>
<td>$&lt; 5^{th}$ percentile</td>
</tr>
</tbody>
</table>
On PM 160, enter follow up code in appropriate column under PROBLEM SUSPECTED

Enter diagnosis under COMMENTS/PROBLEMS

- Underweight
- Overweight
- Obese

Carlos’ weight status is normal so there is nothing to record in the comments
Accurate Measurements Are Critical

**BMI for 5 year old boy**
- Weight: 43.5 lb
- Height: 43.0 in
- BMI = 16.5
- BMI-for-age = 75-84\(^{th}\) percentile
- **Normal range**

*If height is inaccurate:*
- Weight: 43.5 lb
- Height: 42.5 in
- BMI = 17.0
- BMI-for-age = 85-94\(^{th}\) percentile
- **Overweight range**
Practice Using BMI-for-Age Growth Charts

Pete - 4 yrs
Liz - 4 yrs
Gabriela - 4 yrs

Photos from UC Berkeley Longitudinal Study, 1973
**Plot Pete Precisely**

**FIRST STEPS**
1. Select appropriate growth chart
2. Measure standing height
3. Measure weight

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<th>BMI*</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>30 #</td>
<td>34 ½ ″</td>
<td>17.7</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>36 ½ #</td>
<td>38 ″</td>
<td>17.8</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>43 #</td>
<td>41 ″</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Plot Pete Precisely

#### NEXT STEP

**4. Determine BMI Value**

<table>
<thead>
<tr>
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</tr>
</tbody>
</table>
Plot Pete Precisely

NEXT STEP

5. Determine BMI-for-age percentile
Plot Pete Precisely

NEXT STEP

6. Record BMI Percentile on PM 160
   - Estimate a whole number between 1 and 99 that best represents the percentile point plotted on the growth chart
FINAL STEP

7. Determine category and record on PM 160 if needed

- Enter follow up code in appropriate column under PROBLEM SUSPECTED
- Enter diagnosis under COMMENTS/PROBLEMS
  - Underweight
  - Overweight
  - Obese
Let’s Look at Liz

**FIRST STEPS**

1. Select appropriate growth chart
2. Measure standing height
3. Measure weight

<table>
<thead>
<tr>
<th>Date</th>
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</tr>
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<td>33 #</td>
<td>36 ½ ”</td>
<td>17.4</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>37 #</td>
<td>39 ¼ ”</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Let’s Look at Liz

**NEXT STEP**

4. Determine BMI Value

<table>
<thead>
<tr>
<th>Date</th>
<th>Age</th>
<th>Weight</th>
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</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>28 3/4 #</td>
<td>33 1/2 &quot;</td>
<td>18.0</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>33 #</td>
<td>36 1/2 &quot;</td>
<td>17.4</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>37 #</td>
<td>39 1/4 &quot;</td>
<td>16.9</td>
<td></td>
</tr>
</tbody>
</table>
Let’s Look at Liz

NEXT STEP

5. Determine BMI-for-age percentile
Let’s Look at Liz

NEXT STEP

6. Record BMI Percentile on PM 160

  – *Estimate a whole number between 1 and 99 that best represents the percentile point plotted on the growth chart*
Let’s Look at Liz

FINAL STEP

7. Determine category and record on PM 160 if needed
   - Enter follow up code in appropriate column under PROBLEM SUSPECTED
   - Enter diagnosis under COMMENTS/PROBLEMS
     - Underweight
     - Overweight
     - Obese
**Graph Gabriela’s Growth**

**FIRST STEPS**

1. Select appropriate growth chart
2. Measure standing height
3. Measure weight

<table>
<thead>
<tr>
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<th>Age</th>
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<th>BMI*</th>
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<td></td>
</tr>
<tr>
<td>4</td>
<td>32 ½ #</td>
<td>41 ”</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Graph Gabriela’s Growth

NEXT STEP

4. Determine BMI Value

<table>
<thead>
<tr>
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<td>29 ½ #</td>
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<td>14.0</td>
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</tr>
<tr>
<td>4</td>
<td>32 ½ #</td>
<td>41 ”</td>
<td>13.6</td>
<td></td>
</tr>
</tbody>
</table>
Graph

Gabriela’s Growth

NEXT STEP

5. Determine BMI-for-age percentile
Graph Gabriela’s Growth

**NEXT STEP**

6. Record BMI Percentile on PM 160

   - *Estimate a whole number between 1 and 99 that best represents the percentile point plotted on the growth chart*

<table>
<thead>
<tr>
<th>Height (inches)</th>
<th>Weight (lbs)</th>
<th>OZS</th>
<th>BMI Percentile</th>
<th>Blood Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>41</td>
<td>32</td>
<td>8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Graph Gabriela’s Growth

**FINAL STEP**

7. Determine category and record on PM 160 if needed

- Enter follow up code in appropriate column under **PROBLEM SUSPECTED**
- Enter diagnosis under **COMMENTS/PROBLEMS**
  
* Underweight
* Overweight
* Obese
You have learned to:

- Select appropriate **growth chart** for age group
- Identify the **age range** for which Body Mass Index (BMI) screening is used
- Calculate or determine **BMI value**
- Plot **BMI value** on the appropriate growth chart
- Determine **BMI-for-age percentile**
- Identify **weight category**
- **Record results** on PM 160
Resources and Clinical Tools

- Online tutorials
- Online resources
- Growth charts
- BMI wheels
- BMI calculators
- Plotting aids
Color-coded BMI Charts

- 5210 Let’s Go!
  [Website](www.letsgo.org/programs/healthcare/provider-resources/)

- Eat Smart, Move More North Carolina
  [Website](www.eatsmartmovemorenc.com/PediatricObesityTools/PediatricObesityTools.html)
References


• Expert committee recommendations regarding the prevention, assessment, and treatment of child and adolescent overweight and obesity: summary report. *Pediatrics* 120: S164-S192, 2007. [http://pediatrics.aappublications.org/cgi/content/abstract/120/Supplement_4/S164](http://pediatrics.aappublications.org/cgi/content/abstract/120/Supplement_4/S164)

• Recommendations for prevention of childhood obesity. *Pediatrics* 120: S229-S253, 2007. [http://pediatrics.aappublications.org/cgi/content/abstract/120/Supplement_4/S229](http://pediatrics.aappublications.org/cgi/content/abstract/120/Supplement_4/S229)

• The validity of BMI as an indicator of body fatness and risk among children. *Pediatrics* 124: S23-S34, 2009. [http://pediatrics.aappublications.org/cgi/content/abstract/124/Supplement_1/S23](http://pediatrics.aappublications.org/cgi/content/abstract/124/Supplement_1/S23)
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