WHO Growth Standards 2006: What Does It Measure?

By

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Why Measure Growth?

• Growth assessment is the single most easily conducted measurement that best defines the health and nutritional status of children
• It provides an indirect measurement of the quality of life of a population
• Based on the premise that ‘poor’ growth performance reflects deviations from favourable environmental conditions that support optimal growth and development in childhood
Child Growth Charts

- Consist of a series of percentile curves that illustrate the distribution of selected body measurements in the study group.

- Versatile tool to reflect general health, nutrition, and well-being of children.

- Used to monitor growth and development of children during the important childhood period.
The Importance of Child Growth Charts

- Extent and severity of children’s growth failure and malnutrition can be estimated
- Early identification of overweight/obese children
- Facilitate formulation of child health and related policies, planning interventions and monitoring their effectiveness
## History

<table>
<thead>
<tr>
<th>Time</th>
<th>Reference Application</th>
<th>Limitations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1940s</td>
<td>Iowa data by Meridith (1949)</td>
<td>Small and unrepresentative of US children; children mostly from high socioeconomic status</td>
</tr>
<tr>
<td>1960s &amp; 1970s</td>
<td>Harvard and Tanner Growth Curves</td>
<td>Longitudinal data, used by pediatricians in many countries</td>
</tr>
<tr>
<td>1966</td>
<td>Harvard curves established as the international reference</td>
<td>Small sample, limited genetic representativeness and out-of-datedness</td>
</tr>
<tr>
<td>1977</td>
<td>National Center for Health Statistics (NCHS) Growth References</td>
<td>Made up from 2 unrelated survey samples; technical and biological drawbacks</td>
</tr>
<tr>
<td>2000</td>
<td>Centers for Disease Control and Prevention (CDC) Growth Charts (<a href="http://www.cdc.gov/growthcharts">http://www.cdc.gov/growthcharts</a>)</td>
<td>Made up of multiple different studies; mixed feeding; no ethnic differentiation; US children only</td>
</tr>
</tbody>
</table>

(de Onis & Yip, 1996)
Comparison of NCHS (1977) and CDC (2000) Growth Charts

- The CDC (2000) growth charts are a revised version of the NCHS (1977)

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Track children’s growth from 2-18 y</td>
<td>Track children’s growth from 2-20 y</td>
</tr>
<tr>
<td>Absence of 3(^{rd}) and 97(^{th}) percentiles</td>
<td>Inclusion of 3(^{rd}) and 97(^{th}) percentiles</td>
</tr>
<tr>
<td>BMI-for-age: Unavailable</td>
<td>BMI-for-age: 2-20 y</td>
</tr>
<tr>
<td></td>
<td>The 85(^{th}) percentile for BMI was added to identify US children at risk for overweight</td>
</tr>
</tbody>
</table>

(Gibson, 2005)
Why were new standards needed?

- Limitations of the National Center for Health Statistics (NCHS)/WHO growth reference.

- This reference was based on data from several samples of children from a single country; technical and biological drawbacks that make it inadequate to monitor the rapid and changing rate of early childhood growth.


- In 1994, the World Health Assembly (WHA) endorsed the development of a new set of tools to assess infant and young child growth.
Desirable characteristics for anthropometric data to be used in the development of an international growth reference

- Several countries from different geographical regions should be included
- Based on healthy populations with unconstrained growth
- Adequate sample sizes and procedures
- Raw data should be available
- Age range from birth to adolescence
- Standardized quality control and measurements which should be documented
- For adolescents measures of sexual maturity should be available
- Secular trends in growth should be small or absent
World Health Assembly Resolution (1994)

• A need to move beyond past approaches designed to describe *how children grow in a particular region and time* to the more desirable goal of describing *how all children should grow* when their nutritional & health needs are met: the prescriptive approach

• Recommended to develop a *standard* instead of a *reference* to enable a value judgment

• *Multicentre Growth Reference Study (MGRS)* was then undertaken to achieve the above ambitious goal
**REFERENCE**
A tool for grouping and analyzing data and provides a common basis for comparing populations without making inferences about the meaning of observed differences.

**STANDARD**
A tool that indicates a norm or desirable target which allows a value judgment to be made.
Multicentre Growth Reference Study (MGRS),

• Collaborative effort among WHO/United Nations University and several countries

• A community-based, multi-country project was undertaken to develop new growth standards for infants and young children.

• 8,440 Children recruited from 6 countries representing different regions of the world: Brazil, Ghana, India, Norway, Oman, and the United States.
FIG. 1. WHO Multicentre Growth Reference Study map

(de Onis et al., 2004)
Multicentre Growth Reference Study (MGRS)

- New approach was taken to develop the new child growth chart - *Prescriptive Approach* as opposed to traditional descriptive approach.

- This approach describes the growth of children with adherence to recommended health practices and behaviors and based on geographically representative samples of children.

  (de Onis *et al.*, 2004)
Inclusion/Prescriptive criteria

• The study populations lived in socio-economic conditions favourable to growth
• Mothers with no known health or environmental constraints to growth
• Mothers willing to follow MGRS feeding recommendations
  - exclusive or predominant breastfeeding for at least 4-mo
  - introduction of complementary foods by 6-mo of age
  - continued partial breastfeeding to at least 12-mo of age
• No maternal smoking before and after delivery
• Single term birth
• Absence of significant morbidity

(de Onis et al., 2004)
MGRS Study Design

• A combination of longitudinal (from birth to 24-mo) and cross-sectional (18 to 71-mo) study of children

• Mothers and children enrolled at birth and visited at home 21 times (at week 1, 2, 4, & 6); monthly from 2 to 12-mo; and every 2-mo in the 2nd year

(de Onis et al., 2004)
Salient Findings of the MGRS

• Striking similarity in linear growth across the diverse populations that were studied.

• An evaluation of the differences in length of participants from birth to 2 y of age within and among the MGRS sites demonstrated that 70% of the total variance in length was due to interindividual differences and only 3% was due to intersite differences.

• Greater genetic variability resides within populations among populations than among populations.

• The striking similarity in growth is relevant not only to the global community but also increasingly for countries that are, or are becoming, multiethnic in composition such as Canada, the United Kingdom, the United States, and others.
http://www.who.int/childgrowth/en/
How different are the new standards from the old growth charts?

• The prescriptive approach

• Breastfeeding the biological “norm” and establishes the breastfed infant as the normative growth model.

• The pooled sample from the 6 participating countries provides a truly international standard and reiterate the fact that child populations grow similarly across the world’s major regions when their needs for health and care are met.
• New innovative growth indicators beyond height and weight that are particularly useful for monitoring the increasing epidemic of childhood obesity, such as the skinfold thicknesses.

• Growth velocity standards. Health care providers will not have to wait until children cross an attained growth threshold to make the diagnosis of under-nutrition and overweight since velocity standards will enable the early identification of children in the process of becoming under- or over-nourished.

• Lastly, accompanying windows of achievement for six key motor development milestones provides a unique link between physical growth and motor development.
Do these new standards change current estimates of overweight and under-nutrition in children?

- Yes, estimates are going to change because of differences in the pattern of growth between the new standards and the old reference, especially during infancy.
- The magnitude of the change will vary by age, sex, growth indicator, and the underlying nutritional status in the population being evaluated.
- Stunting will be greater throughout childhood compared to the previous international reference.
- Substantial increase in underweight rates during the first half of infancy (i.e., 0-6 months) and a decrease thereafter.
- For wasting during infancy (i.e., up to about 70 cm length) rates will be substantially higher using the new WHO standards.
- With respect to overweight, use of the new WHO standards will result in a greater prevalence that will vary by age, sex and nutritional status of the index population.
The following growth standards have been made available by WHO (2006):

• Attained growth
  – Weight-for-age
  – Length/height-for-age
  – Weight-for-length/height
  – Body mass index-for-age
  – Mid-upper arm circumference-for-age
  – Head circumference-for-age
  – Subscapular skinfold-for-age
  – Triceps skinfold-for-age

• Growth velocity
  – Weight
  – Head circumference
  – Length/height

(Cutberto & de Onis, 2004)
The following growth standards have been made available by WHO (2006):

- Achievement of 6 key motor development milestones (such as sitting, crawling, standing, and walking)
- Provision of a link between physical growth and motor development

(Cutberto & de Onis, 2004)
Figure: Mean length (cm) from birth through 2 y for each of the six sites

Source:
Figure: Mean height (cm) from 2 to 5 y of age for each of the six sites

Source:
Growth velocity based on weight, length and head circumference

The increments on which the velocity standards are based were calculated using the longitudinal sample of 882 children (428 boys and 454 girls) whose mothers complied fully with the MGRS infant-feeding and no-smoking criteria and completed the follow-up period of 24 months.
3rd, 10th, 50th, 90th and 97th centile curves: 2-month length velocity for girls

De Onis et al., 2009
Windows of achievement for six gross motor milestones

- Walking alone
- Standing alone
- Walking with assistance
- Hands- & knees crawling
- Standing with assistance
- Sitting without support

### Comparison of CDC (2000) and WHO Standards (2006)

<table>
<thead>
<tr>
<th></th>
<th>CDC</th>
<th>WHO</th>
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<tbody>
<tr>
<td><strong>Source</strong></td>
<td>Multiple different studies</td>
<td>Primary data</td>
</tr>
<tr>
<td><strong>Study period</strong></td>
<td>1963-1994</td>
<td>1997-2003</td>
</tr>
<tr>
<td><strong>Study subjects</strong></td>
<td>Single country sample (US); mixed feeding</td>
<td>International sample (6 countries) with optimum growth; specific feeding recommendations</td>
</tr>
<tr>
<td><strong>Subjects’ age groups</strong></td>
<td>Birth to 20 y</td>
<td>Birth to 6 y</td>
</tr>
</tbody>
</table>

- WHO Standards (2006) reported lower rates of undernutrition (except during the first 6 mo of life) and higher rates of overweight and obesity compared to CDC (2000)

(de Onis et al., 2007)
Concluding Remarks

- Assessment to ensure every child achieve its expected growth; appropriate follow up are pivotal

- WHO Child Growth Charts (2006) are made relevant and current preferred international growth standards

- For more information:
  http://www.who.int/childgrowth/en
“A future of sustainable development begins with safeguarding the health of every child”

Kofi A. Annan
Secretary-General of the United Nations
(2004)
Thank You
REFERENCES


