Methodological issues in the use of anthropometry for evaluation of nutritional status

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Methodological issues in the use of anthropometry?
Measuring height
Head circumference
Nutritional status of lactating mothers: measuring weight,
Mother's height
Standard normal distribution of child growth and prevalence under the curve between SD ranges
Nutrition through the life cycle

- **Elderly Malnourished**: Reduced capacity to care for baby

- **Woman Malnourished**: Inadequate foetal nutrition
  - Higher maternal mortality

- **Pregnancy Low Weight Gain**: Inadequate foetal nutrition
  - Lower birth weight

- **Baby Low Birth Weight**: Inadequate catch up growth
  - Higher mortality rate
  - Impaired mental development

- **Child Stunted**: Reduced mental capacity
  - Inadequate food, health & care
  - Frequent infections

- **Adolescent Stunted**: Impaired mental development
  - Reduced mental capacity

- **Inadequate foetal nutrition**, **Inadequate food, health & care**, **Inadequate catch up growth**, **Reduced mental capacity**, **Impaired mental development**, **Higher mortality rate**, **Increased risk of adult chronic disease**, **Untimely / inadequate weaning**, **Frequent infections**, **Inadequate food, health & care**

Variation of height-for-age according to maternal education

. Deviation from sex-specific mean literacy rate associated to levels of malnutrition

Source: Adapted from Martorell et al., 1992.
Methods in anthropometry

- Anthropometric indicators
- Reference population
- Cut-off points
- Applications of anthropometry
Anthropometric indicators

- Attained growth
  - Length/height-for-age
  - Weight-for-age
  - BMI-for-age
  - MUAC-for-age
  - Head circumference-for-age
  - Subscapular skinfold-for-age
  - Triceps skinfold-for-age
  - Weight-for-height/length
  - MUAC-for-height/length
Mean weight-for-age z-score

Mean BMI-for-age of the Calcutta boys compared with the French, Dutch, British, and NCHS reference medians

Child growth internationally recognized as an important public health indicator. Numerous surveys but not comparable. WHO’s systematic standardization of data initiated in 1986.
General objectives

- To establish a global nutritional surveillance system
- To compile, standardize and disseminate results of anthropometric surveys performed worldwide

WHO Global Database on Child Growth and Malnutrition
Specific objectives

- Characterize nutritional status
- Enable international comparison
- Identify populations in need
- Evaluate interventions
- Monitor secular trends
- Raise political awareness

WHO Global Database on Child Growth and Malnutrition
Methods: Data standardization

- Use of the NCHS/WHO international reference
- Prevalence of wasting, stunting, underweight and overweight
- Cut-off points in Z-scores: <-2, <-3 and >+2 SD
- Stratification by age, sex, region, urban/rural
- Summary statistics: means & SDs of z-scores

WHO Global Database on Child Growth and Malnutrition
Database Indicators

- Wasting or low weight-for-height (cut-offs <-3 and <-2 SD)
- Stunting or low height-for-age (cut-offs <-3 and <-2 SD)
- Underweight or low weight-for-age (cut-offs <-3 and <-2 SD)
- Overweight or high weight-for-height (cut-off >+2 SD)

WHO Global Database on Child Growth and Malnutrition
Database work-flow

Data search, review of methods and data extraction

Check for completeness and consistencies across indicators and summary statistics

Get back to data holders:
• Clarification
• Further analysis
• Raw data

Assist analysis

Run standard analysis

• Enter data into WHO Global Database
• Archive background documents and raw data

WHO Global Database on Child Growth and Malnutrition
Coverage (January 2005)

- 484 national surveys from 164 countries
- 503 sub-national surveys 158 countries
- 99% children <5 yr in developing countries
- 69% children <5 yr in developed countries
- 2639 references

WHO Global Database on Child Growth and Malnutrition
Global distribution of child underweight

The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement.

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# Global and regional estimates of stunted children in 2000

<table>
<thead>
<tr>
<th>Region</th>
<th>Stunted children (%)</th>
<th>(millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>35</td>
<td>45</td>
</tr>
<tr>
<td>Asia</td>
<td>30</td>
<td>109</td>
</tr>
<tr>
<td>Latin America &amp; Caribbean</td>
<td>14</td>
<td>8</td>
</tr>
<tr>
<td>All developing countries</td>
<td>30</td>
<td>162</td>
</tr>
</tbody>
</table>

Trends of underweight prevalence in children <5 years compared to the MDG Goal in 2015

Subregional projections of underweight prevalence with 95% CI in 2015 compared to MDG Goal

% <-2SD

- Northern Africa: 4.2%
- Sub-Saharan Africa*: 29.2%
- Eastern Africa: 33.3%
- Middle Africa: 23.6%
- Southern Africa: 13.3%
- Western Africa: 13.9%

Wasting and overweight in preschool children

**Overweight estimates in preschool children**

<table>
<thead>
<tr>
<th>Region</th>
<th>Overweight children (%)</th>
<th>(millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>3.9</td>
<td>4.5</td>
</tr>
<tr>
<td>Asia</td>
<td>2.9</td>
<td>10.6</td>
</tr>
<tr>
<td>Latin America &amp; Caribbean</td>
<td>4.4</td>
<td>2.4</td>
</tr>
<tr>
<td>All developing countries</td>
<td>3.3</td>
<td>17.6</td>
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</tbody>
</table>

Trends of overweight in children

Timing of growth faltering
Height-for-age by region

## Estimated burden of 10 leading risk factors

<table>
<thead>
<tr>
<th>Rank</th>
<th>Risk Factor</th>
<th>DALYs (millions)</th>
<th>Global DALYs % total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Underweight</td>
<td>138</td>
<td>9.5%</td>
</tr>
<tr>
<td>2</td>
<td>Unsafe sex</td>
<td>92</td>
<td>6.3%</td>
</tr>
<tr>
<td>3</td>
<td>Blood pressure</td>
<td>64</td>
<td>4.4%</td>
</tr>
<tr>
<td>4</td>
<td>Tobacco</td>
<td>59</td>
<td>4.1%</td>
</tr>
<tr>
<td>5</td>
<td>Alcohol</td>
<td>58</td>
<td>4.0%</td>
</tr>
<tr>
<td>6</td>
<td>Unsafe water, sanitation, and hygiene</td>
<td>54</td>
<td>3.7%</td>
</tr>
<tr>
<td>7</td>
<td>Cholesterol</td>
<td>40</td>
<td>2.8%</td>
</tr>
<tr>
<td>8</td>
<td>Indoor smoke from solid fuels</td>
<td>39</td>
<td>2.6%</td>
</tr>
<tr>
<td>9</td>
<td>Iron deficiency</td>
<td>35</td>
<td>2.4%</td>
</tr>
<tr>
<td>10</td>
<td>Overweight</td>
<td>33</td>
<td>2.3%</td>
</tr>
</tbody>
</table>

## RR of mortality overall and by cause associated with low weight-for-age

<table>
<thead>
<tr>
<th>Cause of Death</th>
<th>&lt; -3 SD</th>
<th>&lt; -2 to -3 SD</th>
<th>-1 to –2 SD</th>
<th>&gt;-1 SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diarrhea</td>
<td>12.50</td>
<td>5.39</td>
<td>2.32</td>
<td>1.0</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>8.09</td>
<td>4.03</td>
<td>2.01</td>
<td>1.0</td>
</tr>
<tr>
<td>Malaria</td>
<td>9.49</td>
<td>4.48</td>
<td>2.12</td>
<td>1.0</td>
</tr>
<tr>
<td>Measles</td>
<td>5.22</td>
<td>3.01</td>
<td>1.73</td>
<td>1.0</td>
</tr>
<tr>
<td>All-cause</td>
<td>8.72</td>
<td>4.24</td>
<td>2.06</td>
<td>1.0</td>
</tr>
</tbody>
</table>

## Mean Z-scores and prevalence by WA category according to WHO mortality Region

<table>
<thead>
<tr>
<th>Region</th>
<th>Mean Z-score</th>
<th>&lt; -3 SD</th>
<th>&gt; -3,&lt; -2 SD</th>
<th>&gt; -2,&lt; -1 SD</th>
<th>&gt; -1 SD,&lt; 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Afr D</td>
<td>-1.54</td>
<td>7.2</td>
<td>25.1</td>
<td>38.3</td>
<td>29.4</td>
</tr>
<tr>
<td>Afr E</td>
<td>-1.5</td>
<td>6.8</td>
<td>24.2</td>
<td>38.3</td>
<td>24.2</td>
</tr>
<tr>
<td>Amr A</td>
<td>0</td>
<td>0.1</td>
<td>2.1</td>
<td>13.6</td>
<td>34.1</td>
</tr>
<tr>
<td>Amr B</td>
<td>-0.35</td>
<td>0.5</td>
<td>4.5</td>
<td>20.8</td>
<td>37.9</td>
</tr>
<tr>
<td>Amr D</td>
<td>-0.84</td>
<td>1.6</td>
<td>10.8</td>
<td>31.3</td>
<td>36.3</td>
</tr>
<tr>
<td>Emr B</td>
<td>-0.6</td>
<td>0.8</td>
<td>7.3</td>
<td>26.3</td>
<td>38.1</td>
</tr>
<tr>
<td>Emr D</td>
<td>-1.33</td>
<td>4.7</td>
<td>20.4</td>
<td>37.8</td>
<td>27.9</td>
</tr>
<tr>
<td>Eur A</td>
<td>0</td>
<td>0.1</td>
<td>2.1</td>
<td>13.6</td>
<td>34.1</td>
</tr>
<tr>
<td>Eur B</td>
<td>-0.57</td>
<td>0.7</td>
<td>6.9</td>
<td>25.7</td>
<td>38.2</td>
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<tr>
<td>Eur C</td>
<td>-0.05</td>
<td>0.2</td>
<td>2.4</td>
<td>14.5</td>
<td>34.9</td>
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<tr>
<td>Sear B</td>
<td>-1.35</td>
<td>5.0</td>
<td>20.8</td>
<td>37.9</td>
<td>27.5</td>
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<tr>
<td>Sear D</td>
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<td>13.4</td>
<td>32.5</td>
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<td>15.5</td>
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<tr>
<td>Wpr A</td>
<td>-0.22</td>
<td>0.3</td>
<td>3.5</td>
<td>18.0</td>
<td>36.9</td>
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<tr>
<td>Wpr B</td>
<td>-1</td>
<td>2.3</td>
<td>13.6</td>
<td>34.1</td>
<td>34.1</td>
</tr>
</tbody>
</table>

Mean Z-scores of infants in the “12-month breastfed pooled data set” relative to the NCHS/WHO reference

A Growth Curve for the 21st Century

The WHO Multicentre Growth Reference Study

Department of Nutrition
Main features of the new International Growth Reference

- Prescriptive (versus descriptive) reference
- International sample
- Breastfed infants
- Healthy populations with unconstrained growth

WHO Multicentre Growth Reference Study
Anthropometric protocols

- Anthropometric equipment
- Training of field workers
- Standardization sessions
- Measurement techniques
- Quality control during data collection (data verification, validation, completeness, etc.)

WHO Multicentre Growth Reference Study
Project timeline of the new international child growth standards

- WHA Resolution (May 1994)
- WHO Expert Committee recommendation (Nov 1993)
- WHO Working Group on Infant Growth
- Growth Curves 1st set
- Growth Curves 2nd set
- WHO Multicentre Growth Reference Study (Nov 03)
- Growth curves construction and testing
- Field implementation