Updated methodology for indicators on stunting (2.2.1) and overweight (2.2.2(a))

**OVERWEIGHT**

*38.9 million*

An estimated 5.7 per cent or 38.9 million children under 5 around the world were overweight in 2020.*

**WASTING**

*45.4 million*

In 2020,* wasting continued to threaten the lives of an estimated 6.7 per cent or 45.4 million children under 5 globally.

**STUNTING**

*149.2 million*

Stunting affected an estimated 22.0 per cent or 149.2 million children under 5 globally in 2020.*
Overview

• Systematic Review of primary sources of data (e.g. surveys)

• Rationale for and overview of updated method for indicators on stunting and overweight

• Country consultation summary
SYSTEMATIC REVIEW
1. WHO/UNICEF report on generating malnutrition estimates

- First WHO/UNICEF report outlining recommended methods for data collection, analysis and reporting
- Multiple agencies worked toward consensus on best recommendations given current knowledge
- Outlines key components for training and data collection
- Includes parameters of data quality to assess
- Research needed to refine and establish cut offs for data quality parameters

Process

In depth review

Standardized format to record information about:

- Sampling
- Training
- Field teams
- Equipment
- Sample coverage
- Data quality checks
- Estimates and trends
- Programme context and information
- Overall assessment and consensus
2. Review sheet and criteria applied

**METHODOLOGY**

- **Sampling** - some key points considered
  - Nationally representative
  - Probabilistic with enough details to understand how all stages were implemented

- **Equipment** - some key points considered
  - Electronic scales
  - Shorr type board

- **Training** - some key points considered
  - Time allotted for anthropometry techniques training
  - Standardization tests
2. Review sheet and criteria applied

METHODOLOGY

• Field work/teams - some key points considered
  • 2 trained measurers
  • Supervision details
  • Call back protocols

• Questionnaires - some key points considered
  • Determination of date of birth
  • Collection of metadata about clothing, etc
  • HH member definition of survey aligned with questionnaire
2. Review sheet and criteria applied

SURVEY COVERAGE

- Some key points considered
- Age range targeted
  - All U5 or other
- Household response rate
- U5 response rate
  - That all eligible children in selected HHs were listed
  - Response rate using correct denominator
  - Check for each indicator (e.g. HAZ, WHZ)

<table>
<thead>
<tr>
<th>Table HH.1: Results of household, women’s, men’s and under-5 interviews</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of households, women, men, and children under 5 by interview results, and household, women’s, men’s and under-5’s response rates, Nigeria, 2016-17</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Residence</th>
<th>Total</th>
<th>Urban</th>
<th>Rural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Households</td>
<td>37,440</td>
<td>12,240</td>
<td>25,200</td>
</tr>
<tr>
<td>Actual Coverage</td>
<td>35,747</td>
<td>11,991</td>
<td>23,756</td>
</tr>
<tr>
<td>Occupied</td>
<td>34,289</td>
<td>11,311</td>
<td>22,978</td>
</tr>
<tr>
<td>Interviewed</td>
<td>33,901</td>
<td>11,104</td>
<td>22,797</td>
</tr>
<tr>
<td>Household response rate</td>
<td>98.9</td>
<td>98.2</td>
<td>99.2</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Geopolitical zone</th>
<th>North Central</th>
<th>North East</th>
<th>North West</th>
<th>South East</th>
<th>South South</th>
<th>South West</th>
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</thead>
<tbody>
<tr>
<td>Total</td>
<td>37,440</td>
<td>5,760</td>
<td>7,880</td>
<td>4,800</td>
<td>5,760</td>
<td>6,720</td>
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<tr>
<td>Urban</td>
<td>6,552</td>
<td>4,220</td>
<td>7,588</td>
<td>4,752</td>
<td>5,326</td>
<td>6,611</td>
</tr>
<tr>
<td>Rural</td>
<td>6,318</td>
<td>4,447</td>
<td>7,424</td>
<td>4,503</td>
<td>5,307</td>
<td>6,120</td>
</tr>
<tr>
<td>Interviewed</td>
<td>6,244</td>
<td>4,390</td>
<td>7,395</td>
<td>4,524</td>
<td>5,354</td>
<td>5,988</td>
</tr>
<tr>
<td>Household response rate</td>
<td>98.8</td>
<td>98.9</td>
<td>99.6</td>
<td>98.5</td>
<td>99.4</td>
<td>97.8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Women</th>
<th>Eligible</th>
<th>36,176</th>
<th>11,689</th>
<th>24,487</th>
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</thead>
<tbody>
<tr>
<td>Interviewed</td>
<td>34,376</td>
<td>10,965</td>
<td>23,411</td>
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<tr>
<td>Women’s response rate</td>
<td>95.0</td>
<td>93.8</td>
<td>95.6</td>
<td></td>
</tr>
<tr>
<td>Women’s overall response rate</td>
<td>93.9</td>
<td>92.1</td>
<td>94.9</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Men</th>
<th>Eligible</th>
<th>16,514</th>
<th>5,450</th>
<th>11,064</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interviewed</td>
<td>15,183</td>
<td>4,800</td>
<td>10,383</td>
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<tr>
<td>Men’s response rate</td>
<td>91.9</td>
<td>89.7</td>
<td>93.0</td>
<td></td>
</tr>
<tr>
<td>Men’s overall response rate</td>
<td>90.9</td>
<td>88.1</td>
<td>92.3</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Children under 5</th>
<th>Eligible</th>
<th>26,578</th>
<th>7,612</th>
<th>20,966</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mothers/caretakers interviewed</td>
<td>28,685</td>
<td>7,471</td>
<td>20,614</td>
<td></td>
</tr>
<tr>
<td>Under-5’s response rate</td>
<td>98.3</td>
<td>98.1</td>
<td>98.3</td>
<td></td>
</tr>
<tr>
<td>Under-5’s overall response rate</td>
<td>97.2</td>
<td>96.4</td>
<td>97.5</td>
<td></td>
</tr>
</tbody>
</table>
2. Review sheet and criteria applied

ANALYSIS

• Notes other available syntax files or software that are similar (MICS, DHS, ENA)
• Use of WHO growth standards and WHO flags
• Calculate age using DOB/DOI and use of day 15 if no day available
• Report at minimum on prevalence of moderate, severe forms of malnutrition as well as mean and SD for HAZ, WHZ and WAZ

• Recommended approach available when using WHO Anthro analyzer and standard STATA and R syntax from JME
Reanalysis

Indicator Definition

Stunting
- Height for age < -2 SD

Severe Wasting
- Weight-for-height < -3SD

Wasting
- Weight-for-height < -2SD

Overweight
- Weight-for-height > 2+SD
2. Review sheet and criteria applied
DATA QUALITY CHECKS

- Key checks
- Age distribution
- Digit preferences
- Implausible values
- Standard deviation

- Do not consider parameters in isolation
- Formal tests or scoring not recommended
- WHO Anthro analyzer can output most and is an easy tool to use
2. Review sheet and criteria applied
ESTIMATES AND TRENDS

- Are trends plausible in time frame for each indicator?
- Is there programmatic evidence for large shifts (e.g. country strategy and actions for overweight reduction)
Renalysis also adds disaggregations missing in the report

Disaggregation produced by reanalysis macros

- Sex of child (male, female)
- Type of residence (urban, rural)
- Wealth Quintile (Q1, Q2, Q3, Q4, Q5)
- Wealth Quintile Grouping (bottom 80%, top 80%, bottom 60%, top 60%, bottom 40%, top 40%)
- Mother’s Education (none, primary, none and primary, secondary, higher, secondary and higher)
- Age in months (6 month groups, 12 month groups, 24 months and under)
- Subnational region
- Sex and age in months
DATA QUALITY

Report of the recommendations to evaluate data quality &
Quick guide of the WHO Anthro Survey Analyser
DATA QUALITY – Missing values

- Age (days): 0.1% (15)
- Weight (kg): 0.6% (88)
- Length or height (cm): 1% (155)
- Sex: 0% (3)
- Geographical region: 0% (0)
DATA QUALITY – Age distribution by age group or age in complete years and sex of the child
Number of cases and proportion of the mismatch between the length/height measuring position and the recommended position, by age group

<table>
<thead>
<tr>
<th>AGE GROUP</th>
<th>EXPECTED POSITION</th>
<th>TOTAL</th>
<th>OBSERVED MISMATCH*</th>
<th>% MISMATCH*</th>
</tr>
</thead>
<tbody>
<tr>
<td>00-11 mo</td>
<td>lying</td>
<td>3504</td>
<td>515</td>
<td>14.7%</td>
</tr>
<tr>
<td>00-08 mo</td>
<td>lying</td>
<td>2780</td>
<td>405</td>
<td>14.6%</td>
</tr>
<tr>
<td>12-23 mo</td>
<td>lying</td>
<td>2980</td>
<td>515</td>
<td>17.3%</td>
</tr>
<tr>
<td>24-35 mo</td>
<td>standing</td>
<td>2797</td>
<td>1861</td>
<td>66.5%</td>
</tr>
<tr>
<td>36-47 mo</td>
<td>standing</td>
<td>2753</td>
<td>1009</td>
<td>36.7%</td>
</tr>
<tr>
<td>48-59 mo</td>
<td>standing</td>
<td>1871</td>
<td>548</td>
<td>29.3%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>13905</td>
<td>4448</td>
<td>32.0%</td>
</tr>
</tbody>
</table>
Possible age distribution patterns in years
Possible age distribution patterns in months
DATA QUALITY – Age distribution

Possible distribution patterns of the month of birth
DATA QUALITY – Age distribution
Larger issue for estimates if heaping is on weight than height
DATA QUALITY – Digit preference

- **Weight (kg)**
  - Digit 0.0: 9.7%
  - Digit 0.1: 10.3%
  - Digit 0.2: 10.3%
  - Digit 0.3: 10.3%
  - Digit 0.4: 10.2%
  - Digit 0.5: 9.9%
  - Digit 0.6: 9.7%
  - Digit 0.7: 9.7%
  - Digit 0.8: 10%
  - Digit 0.9: 10%

- **Length or height (cm)**
  - Digit 0.0: 9.5%
  - Digit 0.1: 11.7%
  - Digit 0.2: 10.9%
  - Digit 0.3: 10.1%
  - Digit 0.4: 9.8%
  - Digit 0.5: 8.6%
  - Digit 0.6: 9%
  - Digit 0.7: 7.4%
  - Digit 0.8: 9.8%

Proportion (%)
DATA QUALITY – Digit preference

- Weight (kg)
- Length or height (cm)
DATA QUALITY – Digit preference in height/length

Possible distribution patterns of integers of height/length in cm

- Ideal
- Pretty good
- Problematic
DATA QUALITY – Digit preference in weight

Possible distribution patterns of integers of weights in kg
DATA QUALITY – Implausible z-score values

• What – Report on the % of cases outside of WHO flags for each HAZ, WHZ and WAZ - unweighted

• Why – above 1% indicative of potential data quality issues in measurements or age determination

• Present – The percentages for each index as well as by team and other disaggregations

![Graph showing percentages for different z-score flags: zBMI_flag (0.2%), zLEN_flag (0.5%), ZWEI_flag (0.1%), ZWFL_flag (0.2%)].
**DATA QUALITY – Standard Deviations (SD)**

*What* – Report the SD for each HAZ, WHZ and WAZ - unweighted

*Why* – large SDs may be a sign of data quality problems and/or population heterogeneity unclear what causes SD’s size and more work needed to determine appropriate interpretation. Have outlined that:

- ✓ Ranges set in 1995 need revision (1.1 to 1.3 for HAZ, 1.0 to 1.2 for WAZ and 0.85 to 1.1 for WHZ)
- ✓ SDs typically wider for HAZ than WHZ or WAZ
- ✓ For HAZ SD typically widest in youngest (0-5 mo) and increases through to age <5 years
- ✓ Should be no substantial difference between boys and girls

*Present* – unweighted SD value for HAZ, WHZ, WAZ as well as by team or other disaggregations
Next steps

- Continue working with the countries to have access to the final reports and databases of the new surveys;
- Continue to improve the review template and criteria used;
- Build capacities in countries by providing training on the tools developed (WHO Anthro Survey Analyzer, etc.);
- Work with partners to:
  - undertake research and develop ranges/limits for data quality determination parameters
  - set additional parameters to determine this quality
UPDATED METHOD
For stunting and overweight
Rationale for country-level model

- To produce a set of estimates that are comparable across place, time, and data source type (i.e., cross-context equivalent)
- To support and harmonize country tracking of progress towards SDGs by filling data gaps with timely estimates
- To overcome statistical limitations of the previous method, and account for measures of inaccuracy around country prevalence estimates

<table>
<thead>
<tr>
<th>Country 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Country 3</td>
</tr>
<tr>
<td>Country 2</td>
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<tr>
<td>Country 1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Country 1</th>
<th>Country 2</th>
<th>Country 3</th>
<th>Country 4</th>
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<tbody>
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<td>2019</td>
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<tr>
<td>2020</td>
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</tbody>
</table>

Start with stunting and overweight country model (2000-2020) for release in 2021

Wasting and severe wasting country model post 2021 (influenced by seasonality)
New Method

- Mixed effect model with random effects for countries
- Fixed effects are covariates and region effects
- Country-level trends from 2000-2020
- Produces confidence intervals
- Uncertainty levels were thoroughly tested
- B-splines: more flexible to fit data points

The complete statistical model took the form:

$$Y_{ij} = Z_{ij} \beta + f(t_{ij}) + g_i(t_{ij}) + \epsilon_{ij}$$

- **$Y_{ij}$** is the logit transformed outcome for country $i$ time-point $j$
- **$t_{ij}$** is the year (i.e., 2005)
- **$Z_{ij}$** are covariates
- **$f(t_{ij})$** represents the global/region time effect
- **$g_i(t_{ij})$** represents the country specific time effect

Cross Validation Results

<table>
<thead>
<tr>
<th>Marker</th>
<th>N</th>
<th>Bias</th>
<th>RMSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stunting</td>
<td>93</td>
<td>0.004</td>
<td>0.0411</td>
</tr>
<tr>
<td>Overweight</td>
<td>89</td>
<td>-0.003</td>
<td>0.0166</td>
</tr>
</tbody>
</table>

Stunting prevalence Kyrgyzstan

Overweight SDI, (Health Access)
New method – sample results

Figure 1: Prevalence of stunting (HAZ<−2), children under 5 years of age, using proposed new method, by country and year. Notes: The blue line shows the proposed JME estimate and the blue shaded region shows the 95% confidence interval; the green dotted line shows the 95% prediction interval. Dots show primary data by type, and vertical error bars show the standard error of the data source.
Stages of updated method development

**2015-2017**

*Developed with Africa region*

- World Bank’s Knowledge for Change Trust Fund grant to develop and test country-models for stunting and overweight for African countries
- Feedback from small group of model experts
- 2 workshops held in East and Southern Africa – overall positive feedback
- Methods in peer-review publication
- Served as the basis for current models

**2019**

*Global Model & Consultation*

- Improvements to Africa model, applied to all regions, including use of covariates
- Global technical consultation in December 2020
- Recommendations to refine the model (e.g. separate analysis for each region), and for undertaking country consultations (e.g. webinars and scenario examples)

**2020**

*Final Model with Latest Data*

Model further refined by applying:

- separate analysis for each region
- survey-specific standard errors
- methods to account for surveys missing age groups
- various covariates tested
- updated dataset
- For country consultation
COUNTRY CONSULTATION

Summary
An email was sent out to the SDG focal points of 202 countries inviting them to the consultation.

111 countries responded to the consultation.

56 countries suggested another contact (i.e., a focal point related to the subject).

28 countries shared new sources.

22 countries raised queries.
GLOBAL OVERVIEW

Prevalence and Number (millions) affected

Our regional and global estimates were released on 4 May 2021

Source: UNICEF, WHO, World Bank Group Joint Child Malnutrition Estimates, 2021 edition. *The collection of household survey data on child height and weight were limited in 2020 due to the physical distancing measures resulting from COVID-19; only four national surveys with at least some field work in 2020 are included in the JME database. The JME estimates are therefore based almost entirely on data collected before 2020 and do not take into account the impact of the COVID-19 pandemic.
Country estimates released

We were able to disseminate estimates for 156 countries.

154 countries had both stunting and overweight estimates

1 country (Canada) only had an overweight estimate because it had no input data for stunting

1 country (Cabo Verde) only had a stunting estimate because it had no input data for overweight

45 countries had no input data. Their estimates are not disseminated publicly but are used in the generation of regional and global aggregates

1 country with an unresolved issue. Its estimate is not disseminated publicly but it is still used in the generation of regional and global aggregates
Country Consultations – Country datasheets

Input Data

<table>
<thead>
<tr>
<th>Year</th>
<th>Sample size</th>
<th>Wasting</th>
<th>Stunting</th>
<th>Overweight</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>7,668</td>
<td>4.9</td>
<td>37.5</td>
<td></td>
<td>Instituto Nacional de Estatística (INE), Ministério da Saúde (MINS), Ministério do Planeamento e do Desenvolvimento Territorial (MINPLAN) and ICF International, Inquérito de Indicadores Múltiplos e de Saúde em Angola 2015-2016. Luanda, Angola e Rockville, Maryland, EUA: INE, MINS, MINPLAN e ICF International (and additional analysis).</td>
</tr>
</tbody>
</table>

Sources not included

<table>
<thead>
<tr>
<th>Year</th>
<th>Sample size</th>
<th>Wasting</th>
<th>Stunting</th>
<th>Overweight</th>
<th>Source</th>
<th>Status of the data quality assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MICS</td>
<td>Angola-secured territory - Decided NOT INCLUSION due to lack of national representativeness.</td>
</tr>
</tbody>
</table>