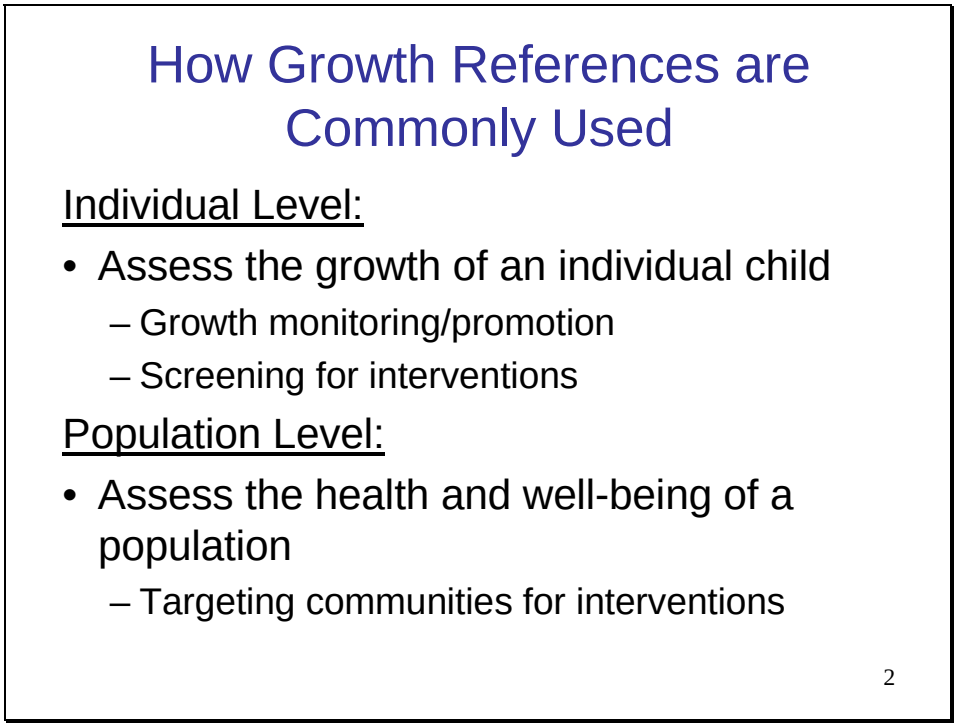
Slide 1

In April 2006, the WHO released new growth standards for children 0-59 m.
This presentation will provide information on what the new WHO child growth standards are, why they were developed, and how the new WHO child growth standards may affect individual and population-level data for program monitoring, evaluation, and decision making.
The new standards contain new indicators such as BMI for age which will be useful in programs dealing with overweight.
The new standards also contain Milestones for Motor Development that can be useful for evaluating the motor development of infants.
However, the focus of the presentation is the use of the new WHO child growth standards for individual and population level assessment, analysis and reporting for undernutrition.

Slide 2



The uses of the NCHS 1978 child growth references and WHO 2006 child growth standards for undernutrition are the same.
For example, both the NCHS 1978 reference and WHO 2006 standard can be used at the individual level to assess a child's weight and height to determine if his or her growth is adequate. This can be accomplished by comparing the child's growth trajectory with the reference growth curve or cut-offs such as -2 SD WAZ, WHZ, or HAZ scores.
Both the NCHS 1978 reference and WHO 2006 standard can also be used at the population level to assess the health and well-being of populations, generally this is done by looking at a percentage below a cut-off, such as -2SD or mean Z score.
However, differences exist between the NCHS 1978 references and WHO 2006 standards.
During this presentation we will be focusing on those differences.

Slide 3

Presentation Outline

- NCHS 1978 Child Growth References
- WHO Multicentre Growth Reference Study
- WHO 2006 Child Growth Standards
- Comparison of WAZ at the Individual Level

5. Differences Between the NCHS 1978 and the WHO 2006 Weight-for-Age (WFA) Growth Curves

- Comparison of WAZ, WHZ, and HAZ at the Population Level

7. Implications for Monitoring, Evaluation and Reporting

3

Slide 4

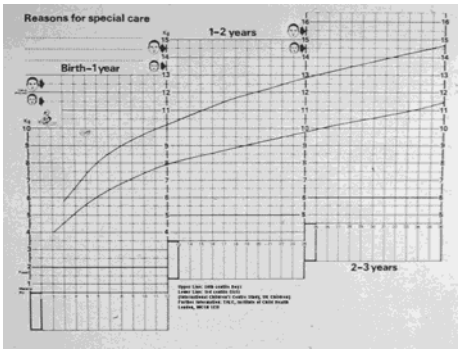
NCHS 1978
Child Growth References

4

Slide 5

NCHS 1978
Child Growth References

- Adopted in 1978 by WHO as the international reference for:
  - Weight-for-age
  - Weight-for-length/height
  - Length/height-for-age



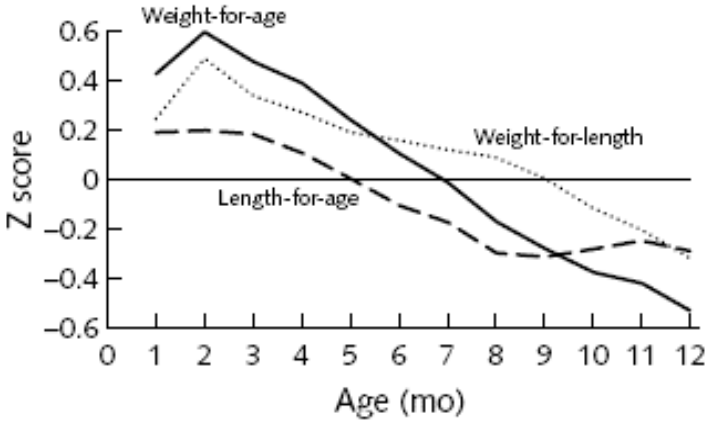
5

The NCHS 1978 references include three indicators:
Weight-for-age: relates to underweight, deficits indicate chronic and/or acute malnutrition
Weight-for-length/height: relates to wasting, deficits indicate acute malnutrition
Length/height-for-age: relates to stunting, deficits indicate chronic malnutrition

Note that for infants and children under 2 y, length is measured lying down or supine. After 2 y, height is measured standing upright.

Slide 6

NCHS 1978
Child Growth References



Garza and de Onis. 2004. Food and Nutrition Bulletin, vol 25, no.1 (supplement 1), p. S6.

6

However, in 1993, the WHO Working Group on Infant Growth found that the growth of healthy breastfed infants differed from the NCHS 1978 child growth references.
This figure shows the mean Z scores of a sample of healthy, breastfed infants 1-12 m of age calculated using the NCHS 1978 reference for weight-for-age, weight-for-length, and length-for-age.
If the growth of the breastfed infants was the same as the sample of children used to create the NCHS 1978 reference, the 3 curves would have followed the horizontal line representing the NCHS 1978 reference median Z score. However this is not the case.
The breastfed sample's weight-for-age Z scores fall progressively from 2 to 12 m, Z scores for weight-for-length show a similar pattern, and those for length-for-age fell through 8 m.
The Working Group's interpretation of these and other findings led it to conclude that new references were necessary.

Slide 7

WHO Multicentre
Growth Reference Study
(1997-2003)

7

As a result, the WHO Multicentre Growth Reference Study was initiated. It was a multi-country study aimed to create a reference reflective of how children worldwide have the potential to grow and develop as long as their basic needs are met, including nutrition, healthcare and environment.

Slide 8

WHO Multicentre
Growth Reference Study

de Onis et al. 2004. Food and Nutrition Bulletin, vol 25, no.1 (supplement 1), p. S15.

8

The study was conducted in 6 countries: Brazil, Ghana, India, Norway, Oman and the United States.

Slide 9

WHO Multicentre Growth Reference Study

Selection criteria used to select samples and construct WHO child growth standards:

- Minimal health, environmental, and economic constraints on growth
- Full-term, single birth
- Absence of significant morbidity
- Non-smoking mother
- Optimal infant and child feeding practices

Longitudinal Sample 0-24 m (n=882):
- Exclusively breastfed or predominantly breastfed for at least 4 m
- Continued breastfeeding for at least 12 m
- Introduction of complementary feeding by 6 m

Cross-sectional sample 18-71 m (n=6669):
- Minimum of 3 m of any breastfeeding

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To construct the new growth standard, the design combined a longitudinal study with a cross-sectional study. The total number of mother-child dyads that complied with the selection criteria listed above and completed the study was 882 from the longitudinal study and 6669 from the cross-sectional study. These children were used to create the new child growth standard.

Slide 10

WHO 2006 Child Growth Standards

10

Slide 11

WHO 2006
Child Growth Standards

Available now:

- Weight-for-age
- Weight-for-length/height
- Length/height-for-age
- Body mass index-for-age
- Windows of milestone achievements

To be available:

- MUAC-for-age
- Head circumference-for-age
- Triceps skinfold thickness-for-age
- Subscapular skinfold thickness-for-age

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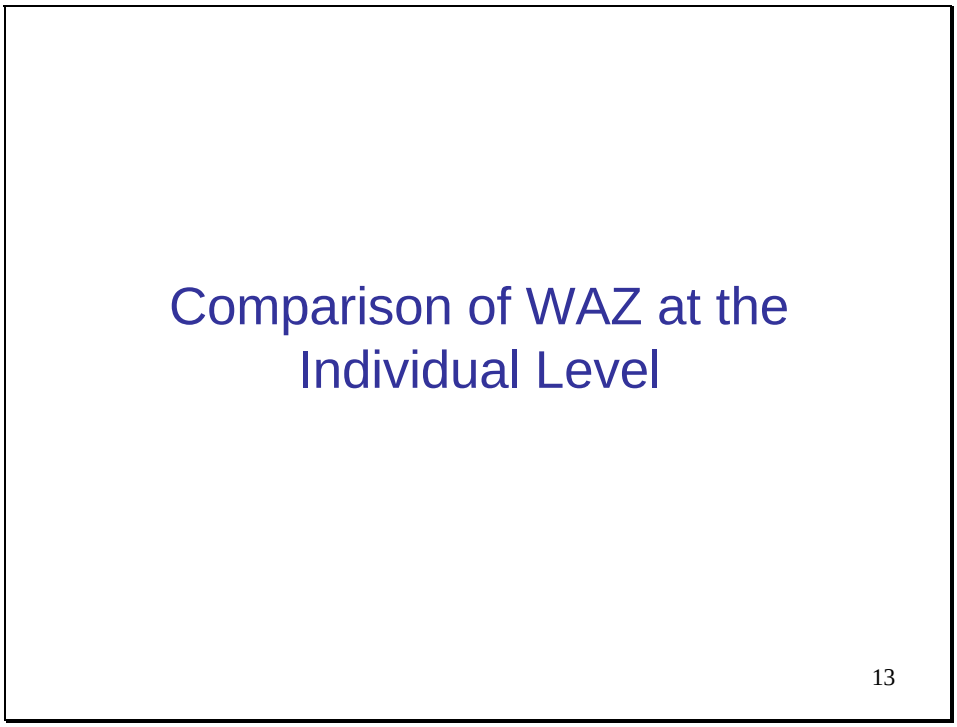
Slide 12

Note that EpiInfo 6.0 is not yet capable of processing anthropometric data using the WHO 2006 child growth standards.
Therefore, to process anthropometric data with the new standards, the WHO Anthro 2005 software must be used.
The software is available on the WHO child growth standards website:
http://www.who.int/childgrowth/en/
A PDA version of the Software WHO Anthro 2005 will be made available. Check the website for its availability.

Slide 13



We will first compare actual weight-for-age Z scores (WAZ) for an individual child using the NCHS 1978 references and WHO 2006 standard. We chose WAZ as the example indicator because it is commonly used in child growth monitoring and promotion programs.

Slide 14

Case Study: Sara

Sara's age	Sara's weight (kg)	NCHS 1978 WAZ score	WHO 2006 WAZ score
0 m	2.4		
1 m	3.5		
3 m	4.5		
6 m	5.4		
9 m	6.0		
11 m	6.4		

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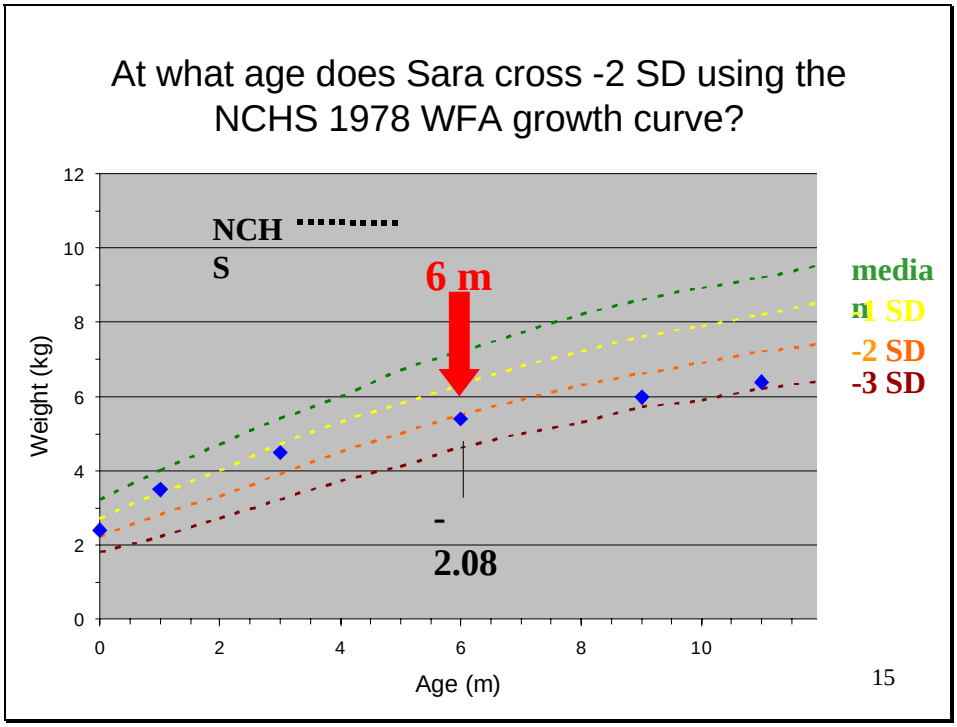
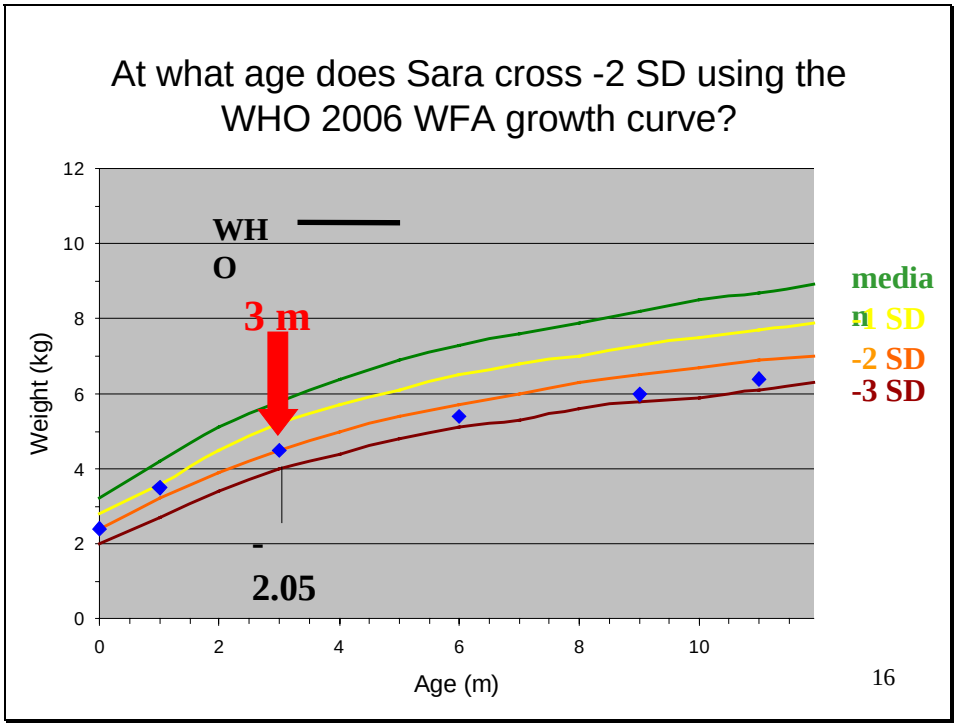
The case study of Sara is used to illustrate the differences between the NCHS 1978 reference and WHO 2006 standard.
The table shows Sara's weight in kilograms recorded for birth, 1, 3, 6, 9, and 11 m of age.

Slide 15



The figure illustrates Sara's weight and age compared to the NCHS 1978 WFA growth curves.
At what age does Sara cross the -2SD curve on this graph?
At 6 m of age, Sara's WAZ according to the NCHS 1978 reference is -2.08.

Slide 16



The figure illustrates Sara's weight and age compared to the WHO 2006 WFA growth curves.
At what age does Sara cross the -2SD curve on this graph?
At 3 m of age, Sara's WAZ according to the WHO 2006 standard is -2.05. Compare this to the age at which Sara was at -2.08 using the NCHS 1978 references.

Slide 17

Case Study: Sara

Sara's age	Sara's weight (kg)	NCHS 1978 WAZ score	WHO 2006 WAZ score
0 m	2.4	-1.68	-1.99
1 m	3.5	-0.81	-1.26
3 m	4.5	-1.21	-2.05
6 m	5.4	-2.08	-2.50
9 m	6.0	-2.65	-2.65
11 m	6.4	-2.78	-2.60

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The table contains Sara's WAZ score calculated using the NCHS 1978 reference and WAZ 2006 standard.

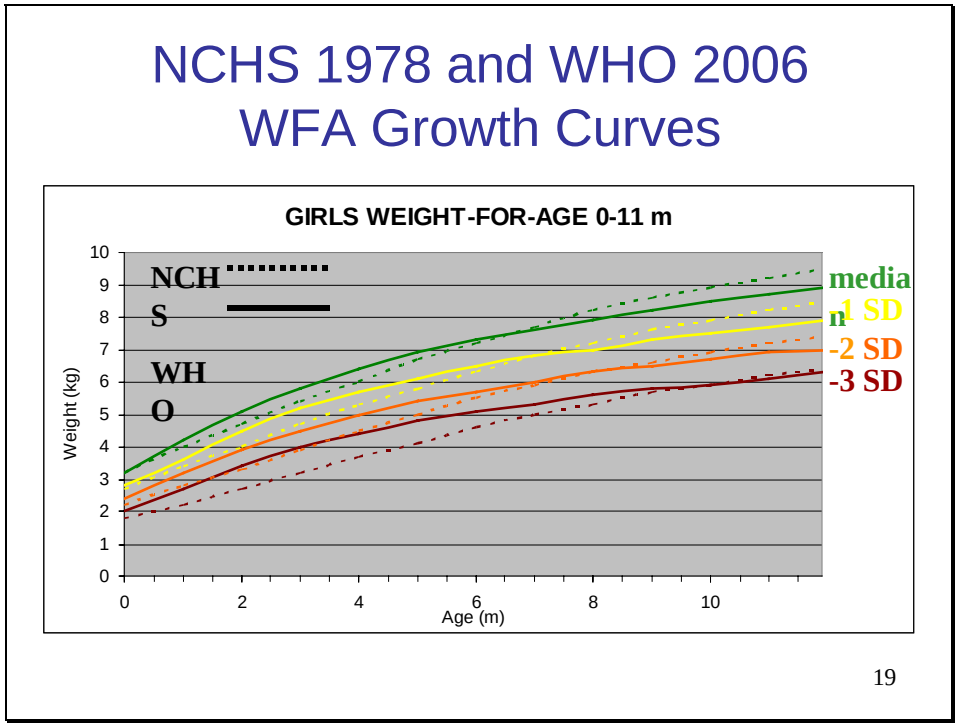
What can we conclude about differences between NCHS 1978 reference and WHO 2006 standard in the case of Sara?
1. Sara's WAZ score is lower from 0-6 m when her Z score is processed by the WHO standard vs. the NCHS reference.
2. For a given weight of a child, the extent of the difference between a Z score processed by the WHO 2006 standard vs. the NCHS reference will depend on the age of the child.

Slide 18

Differences Between the NCHS 1978 and the WHO 2006 Weight-for-Age (WFA) Growth Curves

18

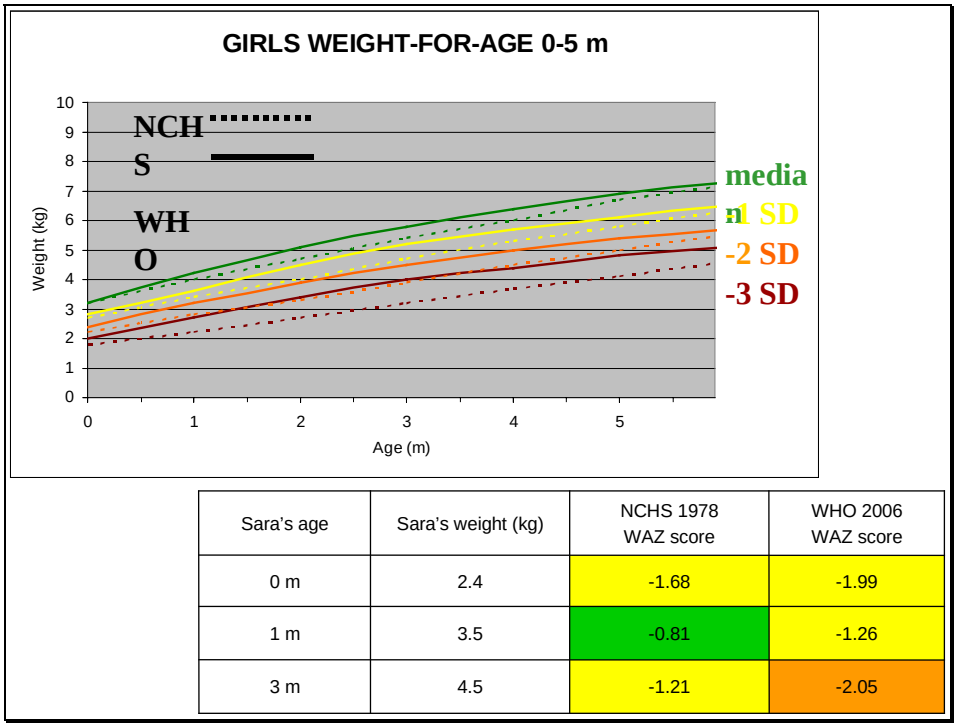
Slide 19



This figure shows the NCHS and WHO WFA growth curves for girls 0-11 m. A similar pattern is found for boys.
For any SD and age along the x axis, it is possible to compare the reference weight of the NCHS curve with that of the WHO curve.

How to interpret:
If the WHO curve is above the NCHS curve, the child will be compared against a heavier weight when using the WHO standards vs. the NCHS references. This will result in a lower WAZ score for a child whose Z score is processed by the WHO standards vs. the NCHS references.
If the NCHS curve is above the WHO curve, the child will be compared against a heavier weight when using the NCHS references vs. the WHO standards. This will result in a lower WAZ score for a child whose Z score is processed by the NCHS references vs. the WHO standards.
For example, at the median, the WHO standard consistently shows a heavier weight than the NCHS references until about 7 m of age. After about 7 m of age, the weight for girls at the median is heavier using the NCHS references.

Slide 20

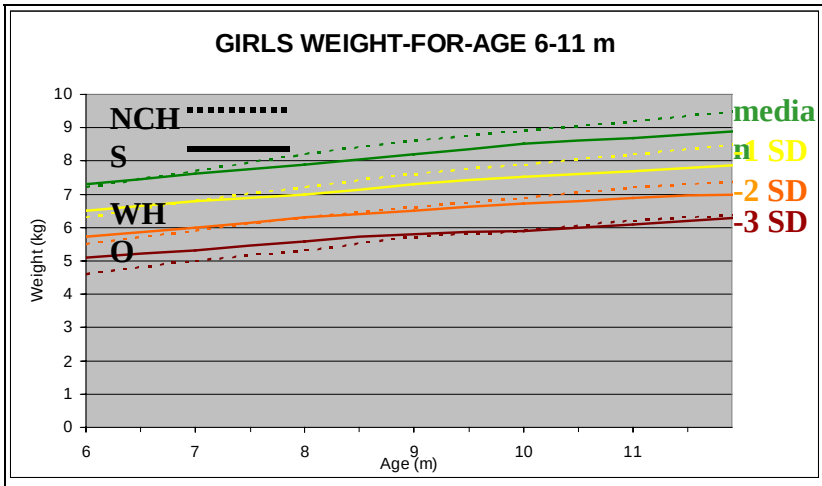


Sara's age	Sara's weight (kg)	NCHS 1978 WAZ score	WHO 2006 WAZ score
0 m	2.4	-1.68	-1.99
1 m	3.5	-0.81	-1.26
3 m	4.5	-1.21	-2.05

This figure shows the NCHS and WHO WFA growth curves for girls 0-5 m. A similar pattern is found for boys.
For any SD and age along the x axis, it is possible to compare the reference weight of the NCHS curve with that of the WHO curve.

General Conclusions:
For the first 6 m of life, the WHO curve is above the NCHS curve for all SDs shown here. The child will therefore be compared against a heavier weight when using the WHO standards vs. the NCHS references – and will have a lower WAZ score by the WHO standards vs. the NCHS references. This pattern is demonstrated by the case study of Sara (refer to table).

Slide 21

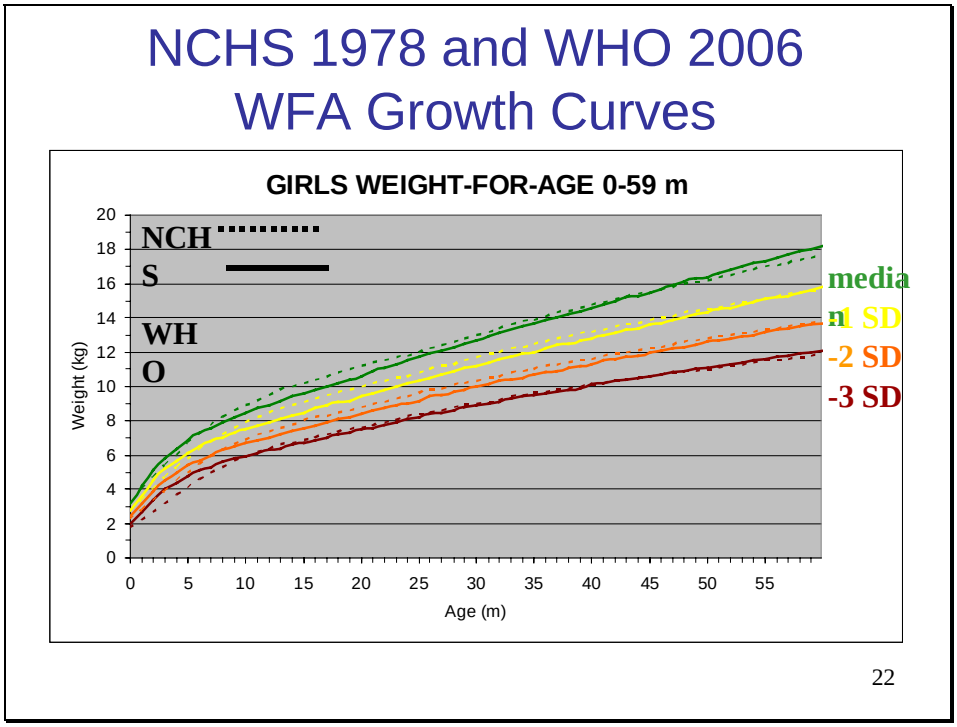


Sara's age	Sara's weight (kg)	NCHS 1978 WAZ score	WHO 2006 WAZ score
6 m	5.4	-2.08	-2.50
9 m	6.0	-2.65	-2.65
11 m	6.4	-2.78	-2.60

This figure shows the NCHS and WHO WFA growth curves for girls 6-11 m. A similar pattern is found for boys.
For any SD and age along the x axis, it is possible to compare the reference weight of the NCHS curve with that of the WHO curve.
Note: From the age of 6-11 m, Sara's WAZ score, by the NCHS references and the WHO standards, falls between -2SD and -3SD (refer to table).

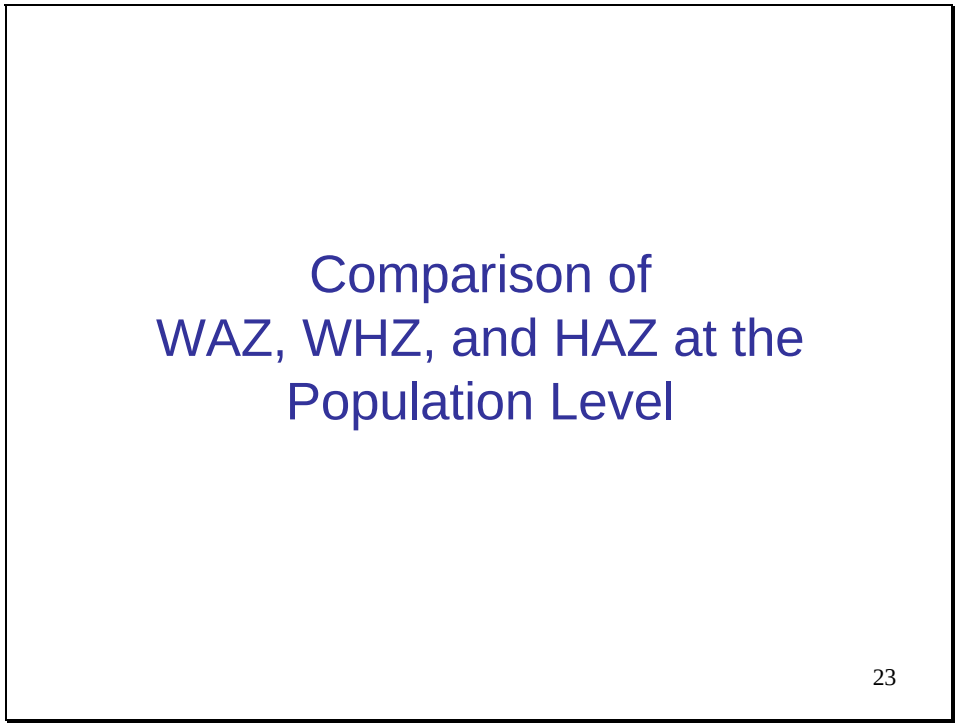
General Conclusions:
At 6 m, the WHO curve is above the NCHS curve for -2SD and -3SD. This explains why Sara's WAZ score at 6 m is lower by the WHO standards vs. the NCHS references.
At 9 m, Sara's WAZ score is the same by the NCHS references and the WHO standards. This is the time when the NCHS and WHO curves for Sara's SD cross.
After 9 m of age, the NCHS curve is above the WHO curve for Sara's SD. This explains why Sara's WAZ score is lower by the NCHS references vs. the WHO standards at 11 m of age.

Slide 22



This figure shows the NCHS and WHO WFA growth curves for girls 0-59 m. A similar pattern is found for boys.

Slide 23



We use indicators and cut-offs to define the prevalence of various types of malnutrition in samples and populations. To estimate the extent of malnutrition in a population, it is common to present the percent of children in a population-based sample that fall below some cut-off for an anthropometric indicator of malnutrition. WAZ is used to reflect undernutrition, WHZ is used for wasting, and HAZ is used for stunting. A common cut-off is -2SD to reflect both moderate and severe malnutrition, and -3SD to reflect severe alone.

Slide 24

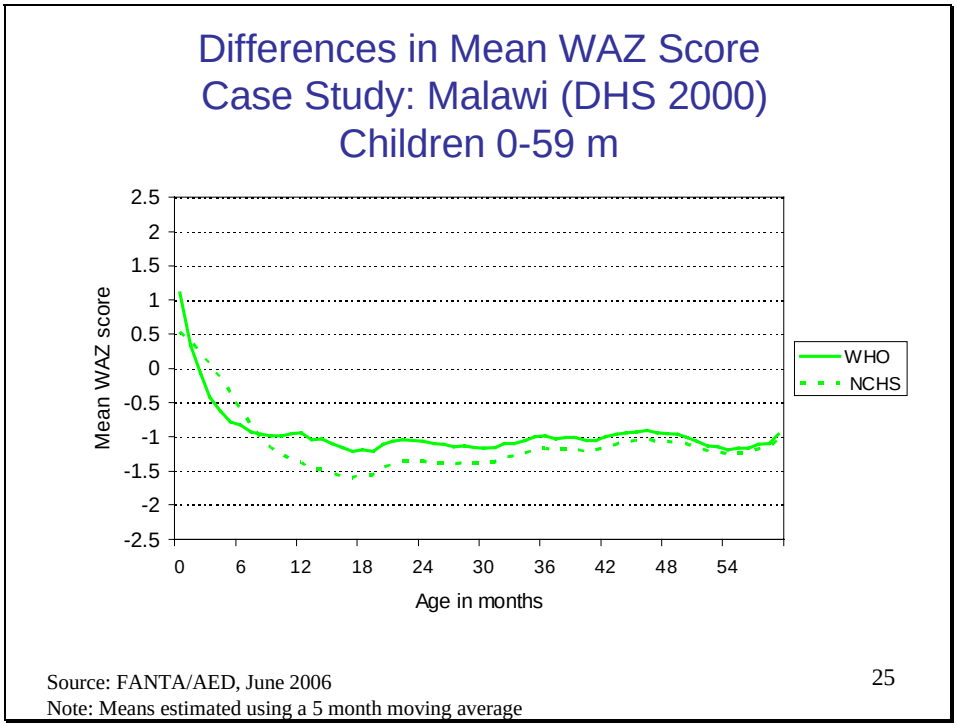
Differences in the Prevalence of Underweight
Case Study: Malawi (DHS 2000)
Children 0-59 m

% children WAZ score <-2 SD	NCHS 1978	WHO 2006	**Change**
0-5 m	4.1	11.8	**+7.7**
6-11 m	22.4	21.2	**-1.2**
12-23 m	33.6	22.4	**-11.2**
24-35 m	29.0	21.5	**-7.5**
36-47 m	19.9	15.2	**-4.7**
48-59 m	19.4	16.3	**-3.1**
Total 0-59 m	**23.3**	**18.6**	**-4.7**

This table shows the difference in the prevalence of *underweight* when a DHS dataset (Malawi) is processed by the NCHS references vs. the WHO standards. We chose Malawi as an example but the pattern is similar for other countries. Data are disaggregated into narrow age bands to demonstrate how the difference in prevalence is dependent on the ages of the children in the sample.

General Conclusions:
Recall that the WHO WFA curve is above the NCHS WFA curve for the -1, -2 and -3SDs during the first 6 m of life - resulting in children 0-5 m having a lower WAZ score by the WHO standards vs. the NCHS references. Note the increase in the % of children 0-5 m with a WAZ score <-2SD when the Malawi data are processed by the WHO standards vs. the NCHS references.
Recall that the WHO and NCHS WFA curves cross for the -1, -2, and -3SDs sometime between 6-11 m. Note the relatively small difference in the % of children 6-11 m with a WAZ score <-2SD when the Malawi data are processed by the WHO standards vs. NCHS references.
Recall that the NCHS curve is [mostly] above the WHO curve for the -1, -2, and -3SDs from 12-59 m - resulting in children 12-59 m [usually] having a lower WAZ score by the NCHS references vs. the WHO standards. Note the decrease in the % of children 12-59 m with a WAZ score <-2SD when the Malawi data are processed by the WHO standards vs. the NCHS references.

Slide 25



This figure uses a 5 m moving average to estimate the mean WAZ score for a DHS dataset (Malawi) processed by the NCHS references and WHO standards. Mean Z scores are used here to show how nutritional status – in this case, underweight – changes with age. If the Malawi data was the same as the NCHS references or the WHO standards, the mean Z score would be zero for all ages. Here we see a rapid decline mean Z score in the first 12 m for data processed by the NCHS references and the WHO standards.

General Conclusions:
As expected, the WHO curve shows a lower mean WAZ score than the NCHS curve for children under 0-5 m. Sometime between 6-11 m, the curves have crossed and the NCHS curve begins to show a lower mean WAZ score than the WHO curve.

Slide 26

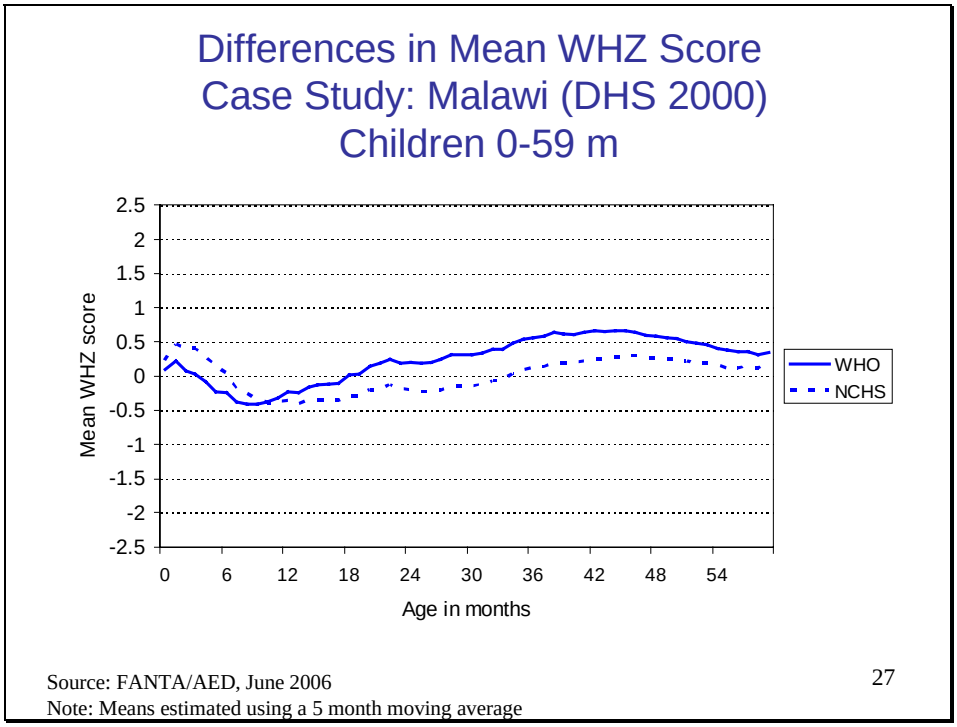
Differences in the Prevalence of Wasting
Case Study: Malawi (DHS 2000)
Children 0-59 m

% children WHZ score <-2 SD	NCHS 1978	WHO 2006	**Change**
0-5 m	4.4	10.8	**+6.4**
6-11 m	8.7	14.0	**+5.3**
12-23 m	9.2	8.0	**-1.2**
24-35 m	4.0	4.2	**+0.2**
36-47 m	2.0	2.0	**+/-0.0**
48-59 m	1.5	1.7	**+0.2**
Total 0-59 m	**5.0**	**6.1**	**+1.1**

This table shows the difference in the prevalence of *wasting* when a DHS dataset (Malawi) is processed by the NCHS references and the WHO standards. Wasting is measured using WHZ score with a cut-off of -2SD. Data are disaggregated into narrow age bands to demonstrate how the difference in prevalence is dependent on the ages of the children in the sample.

General Conclusions:
The WHO WFH curve is above the NCHS WFH curve for the -1, -2 and -3SDs for roughly the first 12 m of life (up to appx. 70cm length) - resulting in children 0-11 m [usually] having a lower WHZ score by the WHO standards vs. the NCHS references. Note the increase in the % of the sample 0-11 m with a WHZ score <-2SD when the data are processed by the WHO standards vs. the NCHS references.
The WHO and NCHS WFH curves cross for the -1, -2, and -3SDs sometime between 12-59 m (or sometime after 70cm). After approximately 12 m (or 70cm), the NCHS and WHO curves trace a similar pattern – particularly for -2SD. Note the relatively small difference in the % of the 12-59 m sample with WHZ score <-2SD when the data are processed by the NCHS references vs. the WHO standards.

Slide 27



This figure uses a 5 m moving average to estimate the mean WHZ score for a DHS dataset (Malawi) processed by the NCHS references and WHO standards.

General Conclusions:
As expected, the WHO curve shows a lower mean WHZ score than the NCHS curve for children roughly 0-11 m. Sometime around 12 m, the curves have crossed and the NCHS curve begins to show a lower mean WHZ score than the WHO curve.

Slide 28

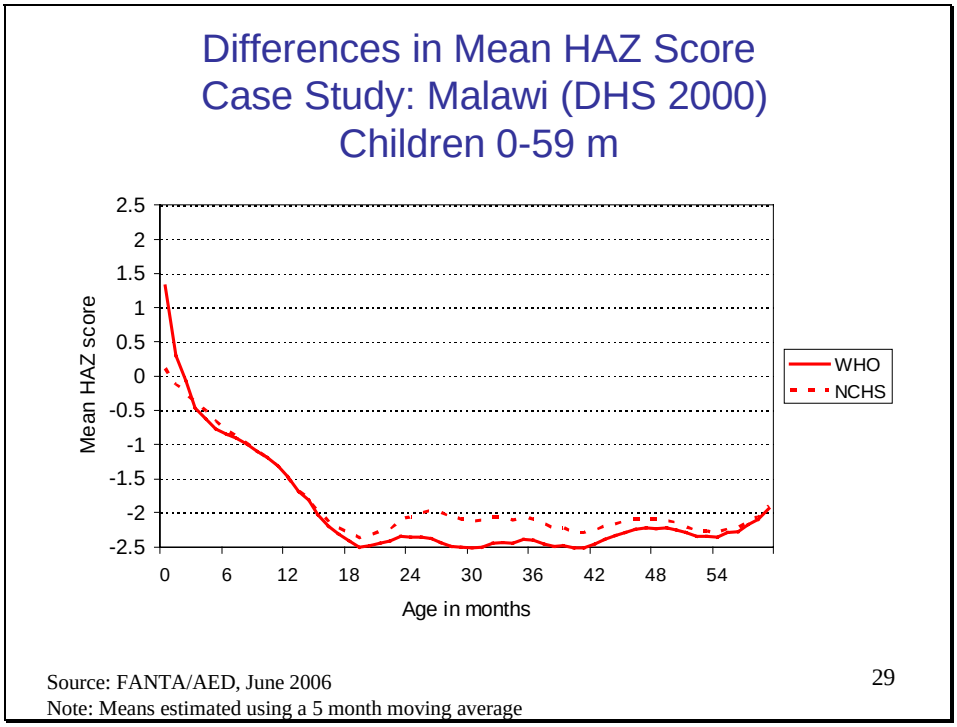
Differences in the Prevalence of Stunting
Case Study: Malawi (DHS 2000)
Children 0-59 m

% children HAZ score <-2 SD	NCHS 1978	WHO 2006	**Change**
0-5 m	10.6	18.5	**+7.9**
6-11 m	24.7	29.4	**+4.7**
12-23 m	55.2	56.7	**+1.5**
24-35 m	52.7	62.6	**+9.9**
36-47 m	57.4	63.7	**+6.3**
48-59 m	55.1	57.0	**+1.9**
Total 0-59 m	**46.6**	**51.8**	**+5.2**

This table shows the difference in the prevalence of *stunting* when a DHS dataset (Malawi) is processed by the NCHS references and the WHO standards. Stunting is measured using HAZ score with a cut-off of
-2SD. Data are disaggregated into narrow age bands to demonstrate how the difference in prevalence is dependent on the ages of the children in the sample.

General Conclusions:
The WHO HFA curve is [mostly] above the NCHS HFA curve for the -1, -2 and -3SDs from 0-59 m - resulting in children 0-59 m [usually] having a lower HAZ score by the WHO standards vs. the NCHS references. Note the increase in the % of the sample 0-59 m with a HAZ Score <-2SD when the data are processed by the WHO standards vs. the NCHS references.

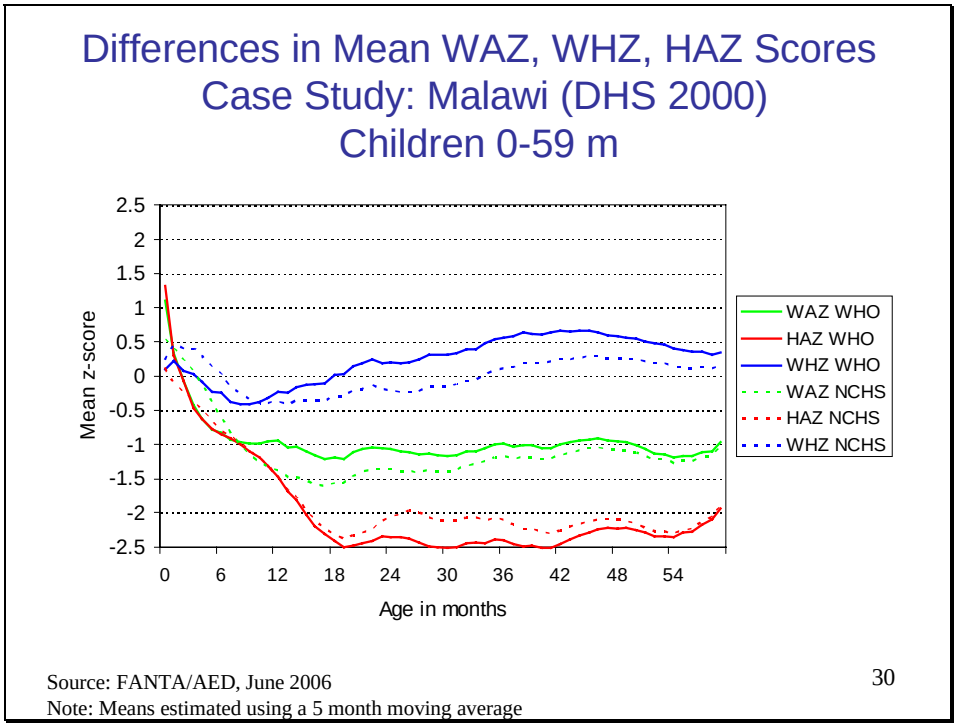
Slide 29



This figure uses a 5 m moving average to estimate the mean HAZ score for a DHS dataset (Malawi) processed by the NCHS references and WHO standards.

General Conclusions:
As expected, the WHO curve shows a lower mean HAZ score than the NCHS curve across [nearly] all ages of children 0-59 m.

Slide 30



This figure shows the mean Weight for Age, Weight for Height, and Height for Age Z scores for a DHS dataset (Malawi) processed by the NCHS references and WHO standards. The pattern is similar for other countries.

Slide 31

Comparison of WAZ, WHZ, and HAZ at the Population Level

What factors influence the extent of the difference in the prevalence of malnutrition estimated by the NCHS 1978 references vs. the WHO 2006 standards?

- Age distribution of sample population
- Level of malnutrition in sample population
- Anthropometric indicator

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When you compare prevalence data for undernutrition, wasting, and stunting using the NCHS 1978 references and the WHO 2006 standards, three factors influence the interpretation.

Slide 32

Implications for Monitoring, Evaluation, and Reporting

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Slide 33

Implications of the WHO 2006 Child Growth Standards: Tips for Monitoring, Evaluation, and Reporting

- When using anthropometric data for M&E or reporting trends across time, the same references must be used to process the anthropometric data for all points in time
- Analysts should check with host government and donor(s) about which references should be used to meet reporting requirements
- For clarity in program reporting: Will be important to label which reference was used for processing the anthropometric data (i.e. NCHS 1978 or WHO 2006)
- Programs may wish to process and report anthropometric data using both set of references until adoption of the WHO 2006 child growth standards is more widespread

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Slide 34

FANTA Project

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The presenters would like to thank CORE for the opportunity to present this work.

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Elisabeth Sommerfelt (AED) conducted the analysis of the Malawi DHS data.

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This presentation is available on the FANTA website www.fantaproject.org and on the CORE website www.coregroup.org.