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Useful Websites

Centers for Disease Control and Prevention (CDC) Growth Charts: www.cdc.gov/growthcharts/

Child Survival Technical Support Project (CSTS) for KPC Material and other useful information: www.childsurvival.com

CORE: USAID/PVO Core Group: www.coregroup.org/

Demographic Household Survey (DHS) Macro Inc.: www.measuredhs.com/

Food and Agriculture Organization (FAO) Nutrition Division: www.fao.org/WAICENT/FAOINFO/ECONOMIC/ESN/NUTRI.HTM

Food Aid Management (FAM) provides USAID documents related to Title II programs for PVOs: www.foodaid.org

Food and Nutrition Technical Assistance Project: www.fantaproject.org

International Life Sciences Institute (ILSI): www.ilsi.org

London School of Hygiene and Tropical Medicine, Public Health Nutrition Unit: www.lshtm.ac.uk/eps/phnu/phnintro.htm

Living Standards Measurement Study (LSMS) of the World Bank: www.worldbank.org/html/prdph/lsms/index.htm

MEASURE I (DHS): www.measuredhs.com/

MEASURE II Evaluation USAID Project: www.cpc.unc.edu/measure/home.html

Nutrition Net: www.nutritionnet.net

Nutrition Surveys and Assessment: www.nutrisurvey.de/

Practical Analysis of Nutrition Data (PANDA) Tulane University: www.tulane.edu/~panda2/

Standing Committee on Nutrition (SCN) of the United Nations: acc.unsystem.org/scn/

SPHERE Project: www.sphereproject.org

USAID's Office of Foreign Disaster Assistance (USAID/OFDA): www.usaid.gov/ofda/resources/index.html

USAID Commodity Reference Guide, Part Two: www.usaid.gov/hum_response/crg/

World Health Organization (WHO) Global Database on Child Growth and Malnutrition: www.who.int/nutgrowthdb/

Glossary

Age chart - A chart that can be used quickly to determine a child's current age by the month and year the child was born; a tool used to determine if reported birth dates match the age of a child given by parents or estimated from the child's appearance.

Anthropometry - The study and technique of taking body measurements, especially for use on a comparison or classification basis.

Arm circumference - A measurement done on the mid-upper arm; a measurement used to assess total body muscle mass and in some circumstances, protein-energy malnutrition.

Asymmetrical - Being lopsided; not having a equal correspondence of form and arrangement of parts on opposite sides of a boundary; an asymmetrical distribution would not have two equal halves on each side of the median.

Bar chart - A chart in which the length of the bars depends on the number of cases in that category and the number of bars depends on the number of categories.

Batch processing - The processing of data for a large group of people at one time.

Bias - A consistent, repeated difference of the sample from the population, in the same direction; sample values that do not center on the population values but are always off in one direction.

Body Mass Index (BMI) - Also known as "Quetelet's index". An index that uses the variables weight and height to measure body fat stores (weight in kilograms divided by the square of height in meters).

Case-control study - A study in which subjects are selected on the basis of whether they are (cases) or are not (controls) receiving benefits of a health and/or nutrition program.

Chi-Squared test - The Chi-Squared Test of Association looks at the statistical significance of an association between a categorical outcome (such as wasted or not wasted) and a categorical determining variable (such as diarrhea in the last two weeks or no diarrhea).

Circumference measuring tape (circumference insertion tape) - A tool used to assess arm circumference; a plastic, non-stretchable tape that is pulled taut around the mid-point of the upper arm to measure circumference of the arm.

Classification system - A system that establishes cut-off points using percentiles, percentages of the median or standard deviations and identifies different levels of nutritional risk.

Cluster sample - The selection of groups that are geographically close to one another for a sample; usually used in instances when lists of households or individuals are not readily available.

Cohort studies - A study which focuses on the same group of people, but uses different individuals over time; a study that uses the same specific population each time but uses different samples.

Confidence interval - An interval that has a specified probability of covering the true population value of a variable or condition.

Cross-section plus over-sample survey - A survey in which data is collected from a random sample and then additional data is collected so that an in-depth view can be gained of a certain group or problem.

Cut-off point - Predetermined risk levels used to differentiate between malnourished and adequately nourished segments of a population.

Design effect - The loss of sampling efficiency resulting from the use of cluster sampling instead of random sampling (a design effect of 2.0 is commonly used for anthropometric and immunization surveys).

Distribution - A display that shows the number of observations (or measurements) and how often they occur.

Edema - The presence of excessive amounts of fluid in the intercellular tissue. It is the key clinical sign of a severe form of protein energy malnutrition.

Epidemiology - The science of the occurrence and determinants of disease in a population.

Epi Info software - A series of micro-computer programs produced by the CDC and WHO, for handling epidemiological data in questionnaire format and for organizing study designs and results into text and tables that may form part of written reports.

External validity - Being able to generalize conclusions drawn from a sample or sub-set to a wider population.

Gomez classification system - A classification system that uses percentage of the median weight-for-age to identify children as being normal or having mild malnutrition, moderate malnutrition or severe malnutrition.

Graph - A drawing that shows the relationship between two sets of numbers as a set of points having coordinates determined by their relationship; a display of numerical relationships.

Growth chart - A graph that is usually used to record a child's weight-for-age in months; a chart typically used by mothers and health workers to determine if a child is experiencing a normal gain in weight.

Growth faltering - A condition identified by emphasizing the direction of growth obtained in serial recordings, rather than actual weight-for-age itself; signified by no change or an actual decrease in measurements.

Growth monitoring and promotion - The practice of following changes in a child's physical development, by regular measurement of weight and sometimes of length with accompanying information to guide the care givers' nutritional and related care.

Histogram - A display that shows the number of observations and how often they occur, usually through the use of vertical bars and a horizontal base that is marked off in equal units.

Household - One person who lives alone or a group of persons, related or unrelated, who share food or make common provisions for food and possibly other essentials for living; the smallest and most common unit of production, consumption and organization in societies.

Index - An index is usually made up of two or more unrelated variables that are used together to measure an underlying characteristic.

Indicator - A measure used at the population level to describe the proportion of a group below a cut-off point. Example: 30 percent of the region's children are below -2 SD for height-for-age.

Intrahousehold distribution - The distribution of food within a household; the act of determining what proportion of the total household food supply each member of the household receives.

Length-for-age - An index of past or chronic nutritional status; an index which assesses the prevalence of stunting.

Local events calendar - A calendar that reflects important local events and seasons that might help a parent pinpoint the birth date of their child.

Longitudinal survey - A survey which follows people over time, to capture data on an evolving situation or problem. Different types of longitudinal surveys include: cohort studies, trend studies and panel studies.

Malnutrition - A nutritional disorder or condition resulting from faulty or inadequate nutrition.

Mean - The average value for a set of data; a measure of central location obtained by adding all the data items and dividing by the number of items.

Measurement error - The error that can result in a survey from incorrect (anthropometric) measurements being taken.

Median - A measure of central location for a set of data; the value that falls in the middle of a set of data when all the values are ordered from lowest to highest.

Morbidity - A condition resulting from or pertaining to disease; illness.

Mortality rate - Death rate; frequency of number of deaths in proportion to a population in a given period of time; death.

NCHS reference standards - Growth percentiles developed by the National Center for Health Statistics in the US that provide standards for weight-for-age, length-for-age and weight-for-length.

Normal distribution - A normal distribution takes a bell-shape and has the following characteristics: the highest point occurs at the mean; it is symmetric; the standard deviation determines the width of the distribution; and it can be described with only two numbers: the mean and the standard deviation.

Numeric value - A value expressed as a number or numeral.

Nutritional surveillance - A system of data collection and application; systems that are based on routinely compiled data and that monitor changes in variables over time, give warning of impending crisis or monitor the effectiveness/ineffectiveness of existing programs and policies; the continuous monitoring of the nutritional status of a specific group.

One-tailed test - A statistical test to detect a difference in means between two populations in a specified direction (i.e. to detect improved nutritional status).

One time assessment - The practice of assessing nutritional status through the use of measurements taken on one occasion, usually used to screen participants for immediate interventions.

Panel studies - A type of longitudinal survey that studies the same people over time.

Percentiles - A number that corresponds to one of 100 equal divisions in a range of values; a measure of relative location. For example, the 60th percentile means that 60% of values in the data set are less than or equal to it and (100 - 60) 40% are greater than or equal to it.

Percentage of the median - A fraction or ratio based on a total of 100, where the median value of the data set equals 100; a value that equals a proportion or part of a distribution where the median represents 100 percent.

Population - The entire group of people that is the focus of the study (everyone in the country, or those in a particular location, or a special ethnic, economic or age group).

Prevalence - The proportion of the population that has a condition of interest (i.e. wasting) at a specific point in time; a measure of a condition that is independent of the size of the population; a value that is always between 0 and 1.

Protein-energy malnutrition - Under-nutrition that results in an individual not receiving adequate protein or calories for normal growth, body maintenance, and the energy necessary for ordinary human activities.

References or reference standards - Measurement data collected on representative, healthy populations through standardized methods; a data set that allows comparisons to be made between its values and individuals or populations being measured.

Reflexive study design – One group pre-/post-test. A study in which one population group is studied on two different occasions to compare changes over time.

Risk - The possibility of suffering harm; danger; "a continuous variable relating to the likelihood that a defined undesirable outcome will occur."

Sample - A part or subset of the population used to supply information about the whole population.

Sample size - The number of households or persons selected to be included in a sample or survey.

Sampling - The technique of selecting a representative part of the population for the purpose of determining characteristics of the whole population.

Sampling error - The difference between the results obtained from a survey sample and those that would have been obtained if the entire population was surveyed. The size of sampling error varies both with the size of the sample and with the percentages giving a particular response.

Screening - The practice of distinguishing between individuals who should be enrolled in a program/intervention and those who should not be enrolled; a tool for identifying individuals at risk; to examine carefully to determine suitability.

Self-selection - The act whereby individuals determine their participation in some activity or event, because of underlying values, characteristics or circumstances.

Simple cross-section survey - A survey that collects data using random sampling; a survey that gives all individuals or household in the study area an equal chance of being chosen for the survey.

Simple random sample - The results of a method of sampling that gives everyone an equal chance of being selected; the simplest form of probability sampling; a sample in which an individual's selection is independent of the selection of any other individual.

Skewed distribution - A distribution in which one side is unequal to the other side; a distribution in which the two sides do not mirror each other across the center line of the mean.

Skinfold calipers - A tool used to assess skinfold thickness by measuring the thickness of the skin pinched between its prongs.

Skinfold thickness - A measurement that provides an estimate of subcutaneous fat deposits, which in turn provides information on total body fat.

Specificity - Characteristic of a classification system that correctly identifies children who are not at risk; the probability that a healthy individual will be classified as healthy; a system with few false positives.

Spring scale - A scale that measures weight by the amount a spring is pulled by the object being weighed; a hanging scale.

Standard deviation - A statistical measure of dispersion away from the mean; the square root of the variance.

Stratified sample - A method of sampling that ensures proportional representation from all sub-groups or strata.

Stratified survey - A survey that chooses participants randomly after they have been divided into the applicable strata or sub-groups.

Student's t-test - A statistical test to determine if there is a significant difference in means of a continuous variable between two groups.

Stunting - A slowing of skeletal growth that results in reduced stature or length; a condition that usually results from extended periods of inadequate food intake and infection, especially during the years of greatest growth for children.

Subcutaneous fat - Fat located just underneath the skin; fat that is used as a measure of total body fat stores in skinfold thickness measurements.

Subscapular area - The site just below the shoulder blade; situated below or on the underside of the scapula.

Summary statistics - Statistics that are used to describe the center and spread of the distribution of a variable. Statistics that usually make up such a summary include: the mean, standard deviation, median, variance, mode, total, standard error, and upper and lower quartiles.

Survey - A method of gathering information about a large number of people by talking to a few of them; a way to collect information on people's needs, behavior, attitudes, environment and opinions, as well as on such personal characteristics as age, income and occupation.

Systematic sample - A modification of a simple random sample that consists of picking individuals at regular intervals from a random list.

Tolerated sampling error - The amount of difference permissible between the estimate (results from a survey sample) and the actual value in the population.

Trend assessment - The process of tracking nutritional progress over time; examples of nutritional trend assessment include growth monitoring and nutritional surveillance.

Trend studies - A type of longitudinal survey that uses different individuals for study over time; a study which uses different households in each survey, but in which each sample represents the same general population at different times.

Triceps - The muscle at the back of the upper arm; a large three-headed muscle running along the back of the upper arm and functioning to extend the forearm.

Two-tailed Test - A statistical test to detect a difference in means between two populations regardless of the direction of the difference.

Underweight - A condition measured by weight-for-age; a condition that can also act as a composite measure of stunting and wasting.

Variable - A quantity that may vary from object to object; a characteristic of a unit.

Wasting - A condition measured by weight-for-height; a condition that results from the loss of both body tissue and fat in a body; a condition that usually reflects severely inadequate food intake and infection happening at present.

Waterlow classification system - A nutritional classification system that uses percentage of the median of height-for-age and weight-for-height in combination to identify children who are wasted, stunted or both.

Weighing trousers - A pair of little pants that a child can step into and be suspended for weighing from a hanging scale.

Weight-for-age - An index of short and long term malnutrition referred to as undernutrition; a valuable index for use with very young children or when length measurements are difficult to do accurately.

Weight-for-height - An index of current nutritional status also referred to as wasting.

Weighting - A data analysis process that involves adjusting key variables used for sample selection to their actual proportions in the population.

Z-score - A statistical measure of the distance, in units of standard deviations, of a value from the mean; the standardized value for an item based on the mean and standard deviation of a data set; a standardized value computed by subtracting the mean from the data value and then dividing the results by the standard deviation.

Acronyms

BMI	Body Mass Index
CDC	Centers for Disease Control and Prevention
Cm	Centimeters
CS	Cooperating Sponsor
DCHA	Bureau for Democracy, Conflict and Humanitarian Assistance
DHS	Demographic and Health Survey
DHS-III	Demographic and Health Survey (third phase DHS surveys conducted in-country)
DOB	Date of birth
DOM	Date of measurement
EBF	Exclusive breastfeeding
FFP	Office of Food for Peace of the US Agency for International Development
GMP	Growth monitoring and promotion
HAZ	Height for age Z-score
HAM	Height for age % median
HAP	Height for age percentile
Ht	Height
ID	Identification
Kgs	Kilograms
KPC	Knowledge Practice and Coverage
MCH	Maternal and child health
MUAC	Mid-upper arm circumference
NGO	Non-governmental organization
PVO	Private voluntary organization
SPSS	Statistical Package for Social Sciences (software)
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
WAZ	Weight for age Z-score
WAM	Weight for age % median
WAP	Weight for age Percentile
WHZ	Weight for height Z-score
WHM	Weight for height for age % median
WHP	Weight for height percentile
WHO	World Health Organization
Wt	Weight

APPENDIX

I. Calculating Z-scores

The annex describes calculating the preferred expression of common anthropometric indices: Z-score.

Using Distributions by Standard Deviation

The reference population data are available with the mean measurement values and the measurement values for up to +/- 3 SD displayed, for the three nutritional status indices (see also www.fantaproject.org). These values are given for each month of age up to 119 months, for both boys and girls. The data may be viewed in the following three formats: (1) table; (2) graph; and (3) spreadsheet. An example of how a table of weight-for-age values for boys can be used is as follows.

Procedure

A 19-month-old boy who weighs 9.8 kg is compared to the reference standards. Use a distribution of the reference standards that already has values for the standard deviations calculated. First, the appropriate distribution should be consulted.

Example: Part of the table below is the weight-for-age by standard deviation for boys. Age in months is listed in the far left column. The mean or expected values for an "average" healthy boy of each age is located in the middle column. The measurement values range from -3 to +3 SDs, with the standard deviation for the lower and upper halves of the distribution also shown. The correct line of the table should be found (lines vary by months of age or centimeters of length). The child's measurement should then be pinpointed along this line.

Example: In this case, we need to locate the line for the age 19 months and then find where 9.8 kg falls. The table shows that such a child falls between -2 and -1 SD.

Therefore, we would say that a 19 month old boy who weighed 9.8 kg is between -2 and -1 SD from the mean. To obtain a more accurate statistic, a Z-score would have to be calculated.

Calculating Z-scores

When the mean and standard deviation for a set of data are available, as they are with the reference standards, a Z-score can be calculated. In this case, a Z-score calculated for an individual tells exactly how many standard deviation units his measurements are away from the mean of the reference distribution. A positive Z-score means that an individual's measurements are higher than the reference mean and a negative Z-score means that the measurements are lower than the reference mean. The advantage of calculating a Z-score is that it provides more precision than just locating a position on a table, as we did above. Only the mean and standard deviation are needed.

Procedure

Assume we have the same 19 month old boy from the example above, who weighs 9.8 kilograms. If we look at the reference standards for weight-for-age, we see that the

Weight (kg) for age distribution by standard deviation for boys

Age Group (months)	Lower S.D.	-3 S.D.	-2 S.D.	-1 S.D.	Mean	+1 S.D.	+2 S.D.	+3 S.D.	Upper S.D.
12	1.0	7.1	8.1	9.1	10.2	11.3	12.4	13.5	1.1
13	1.0	7.3	8.3	9.4	10.4	11.5	12.7	13.8	1.1
14	1.1	7.5	8.5	9.6	10.7	11.8	13.0	14.1	1.2
15	1.1	7.6	8.7	9.8	10.9	12.0	13.2	14.4	1.2
16	1.1	7.7	8.8	10.0	11.1	12.3	13.5	14.7	1.2
17	1.1	7.8	9.0	10.1	11.3	12.5	13.7	14.9	1.2
18	1.2	7.9	9.1	10.3	11.5	12.7	13.9	15.2	1.2
19	1.2	8.0	9.2	10.5	11.7	12.9	14.1	15.4	1.2
20	1.2	8.1	9.4	10.6	11.8	13.1	14.4	15.6	1.3
21	1.3	8.3	9.5	10.8	12.0	13.3	14.6	15.8	1.3
22	1.3	8.4	9.7	10.9	12.2	13.5	14.8	16.0	1.3
23	1.3	8.5	9.8	11.1	12.4	13.7	15.0	16.2	1.3
24	1.1	9.0	10.1	11.2	12.3	14.0	15.7	17.4	1.7

"average" healthy boy of 19 months weighs 11.7 kilograms. Since this child is obviously under the mean of 11.7 kilograms, we need to check the lower standard deviation value (remember: with weight-for-age the lower and upper standard deviations might differ!). It is 1.2 kilograms. With these two pieces of information, we can calculate the Z-score of a child's weight-for-age, using the following procedures:

Subtract the mean weight from the actual weight of the child. The results in this case will be negative.

Example: 9.8 kg - 11.7 kg = -1.9

Divide the result by the standard deviation for the child's age and gender.

Example: -1.9 / 1.2 sd = -1.58 SD units

The resulting number is the Z-score for that child.

Example: The Z-score for a 19 month old boy who weighs 9.8 kg is -1.58 standard deviation units.

This procedure can be repeated with the appropriate graphs or tables to calculate the Z-scores for length-for-age and weight-for-height.

Percent of the Median

Procedure

For this example, we will assume we have just measured the length of a girl who is 24 months old. This girl is 64.9 cm long. We want to use percentages of the median to compare her to the reference standards. Using the percentile distribution for the appropriate index (weight-for-age, length-for-age or weight-for-length) and sex, find the measurement that corresponds to the 50th percentile (remember the 50th percentile is the same as the median).

Example: From a table of reference values we learn that the 50th percentile length measurement for a 24 month old girl is 86.5 cm.

Divide the measurement of the individual child by the appropriate median measurement.

Example: Our girl is 64.9 cm.
The median value for girls is 86.5 cm.

64.9 cm / 86.5 cm = .75

Multiply this fraction by 100, to convert it to a percentage.

Example: 0.75 x 100 = 75%

A 24 month old girl who is 64.9 cm long is 75 percent of the median. The procedure would be the same for a child who has a measurement that is larger than the median. That child would, however, be over 100 percent of the median.

The main disadvantage of this system is the lack of exact correspondence with a fixed point of the distribution across age or height status. For example, depending on the child's age, 80% of the median weight-for-age might be above or below -2 Z-scores. In terms of health, being below or above -2 Z-scores would result in a different classification of risk. In addition, typical cut-offs for percent of median are different for different anthropometric indices.

To approximate a cut-off of -2 Z-scores, the usual cut-off for low height-for-age is 90%, and for low weight-for-height and low weight-for-age, 80% of the median.

The table below is the reference for length-for-age for boys aged 0-12 months. The value given in the "Mean" column is the average length in centimeters that we would expect for a healthy boy at each age. Age in months is given in the far left-hand column. The column next to it shows the number of centimeters needed to equal 1 standard deviation unit (you should notice that the number of centimeters in one standard deviation unit generally increases as age goes up).

In the example of a 3 month old boy, we can see under the mean column in the table, that 61.1 cm is the expectation for a healthy boy. If we had measured a 3 month old boy who was 2.6 cm under this expectation (or 58.5 cm), we would find that this measurement falls exactly 1 standard deviation unit under the mean. Therefore, we could state that this individual child is -1 standard deviation from the mean or average (expectation) for length-for-age. A 12 month old boy who measured 2.7 cm under the expectation for his age (or 73.4 cm), would also be 1 standard deviation unit under the mean length-for-age, for his age. Standard deviation provides an easy way to tell what measurements are of equal concern when we are measuring boys and girls of different ages.

Length (cm) for age (months) distribution by standard deviation for boys

Age Group (months)	Lower S.D.	-3 S.D.	-2 S.D.	-1 S.D.	Mean	+1 S.D.	+2 S.D.	+3 S.D.	Upper S.D.
0	2.3	43.6	45.9	48.2	**50.5**	52.8	55.1	57.3	2.3
1	2.5	47.2	49.7	52.1	**54.6**	57.0	59.5	61.9	2.5
2	2.6	50.4	52.9	55.5	**58.1**	60.7	63.2	65.8	2.6
3	2.6	53.2	55.8	58.5	**61.1**	63.7	66.4	69.0	2.6
4	2.7	55.6	58.3	61.0	**63.7**	66.4	69.1	71.7	2.7
5	2.7	57.8	60.5	63.2	**65.9**	68.6	71.3	74.0	2.7
6	2.7	59.8	62.4	65.1	**67.8**	70.5	73.2	75.9	2.7
7	2.7	61.5	64.1	66.8	**69.5**	72.2	74.8	77.5	2.7
8	2.7	63.0	65.7	68.3	**71.0**	73.6	76.3	78.9	2.7
9	2.6	64.4	67.0	69.7	**72.3**	75.0	77.6	80.3	2.6
10	2.6	65.7	68.3	71.0	**73.6**	76.3	78.9	81.6	2.6
11	2.7	66.9	69.6	72.2	**74.9**	77.5	80.2	82.9	2.7
12	2.7	68.0	70.7	73.4	**76.1**	78.7	81.5	84.2	2.7

APPENDIX

Uses of Anthropometric Data

2.

Appendix adapted from World Health Organization (1995).

Anthropometric indicators can be classified according to the objectives of their use, which include the following: (The order of listing is dictated by various methodological considerations discussed later).

Identification of individuals or populations at risk. In general, this requires data based upon indicators of impaired performance, health or survival. Depending on the specific objective, the anthropometric indicators should:

- reflect past or present risk; or
- predict future risk

An indicator may reflect both present and future risk; for instance, an indicator of present malnutrition may also be a predictor of an increased risk of mortality in the future. However, a reflective indicator of past problems may have no value as a predictor of future risk; for example, stunting of growth in early childhood as a result of malnutrition may persist throughout life, but with age probably becomes less reliably predictive of future risk.

Indicators of this type might be used in the risk approach to identification of health problems and potential interventions, although, the risk approach may have little value in predicting or evaluating the benefit derived from interventions.

Selection of individuals or populations for an intervention. In this application, indicators should predict the benefit to be derived from the intervention.

The distinction between indicators of risk and indicators of benefit is not widely appreciated, yet it is paramount for developing and targeting interventions. Some indicators of present or future risk may also predict benefit, but this is not necessarily the case. Low maternal height, for example, predicts low birth weight, but, in contrast to low maternal weight in the same population, does not predict any benefit of providing an improved diet to pregnant women. By the same token, predictors of benefit may not be good predictors of risk.

Anthropometry provides important indicators of overall socioeconomic development among the poorest members of a population. Data on stunting in children and adults reflects socioeconomic conditions that are not conducive to good health and nutrition. Thus, stunting in young children may be used effectively to target development programs.

Evaluation of the effects of changing nutritional, health, or socioeconomic influences, including interventions. For this purpose, indicators should reflect responses to past and present interventions. This is the case with Title II program evaluations.

Change in weight-for-height (wasting) is a good example of an indicator of short-term response in a wasted child being treated for malnutrition, whereas a decrease in the prevalence of stunting at the population level is a long-term indicator that social development is benefiting the poor as well as the comparatively affluent. On the other hand, a decrease in the prevalence of low birth weight might be used to indicate success in such activities as controlling malaria during pregnancy.

In describing an indicator of response, the possible lag between the start of an intervention and the time when a response becomes apparent is an important consideration. At the individual level, a wasted infant will respond to improved nutrition first by putting on weight and then by "catching up" in linear growth. At the population level, however, decades may elapse before improvements can be seen in adult height.

Excluding individuals from high-risk treatments, from employment or from certain benefits. Decisions regarding an individual's inclusion in, or exclusion from, a high-risk treatment protocol, consideration for employment in a particular setting (e.g. an occupation requiring appreciable physical strength), or admission to certain benefits (e.g. low life-insurance rates) depend on indicators that predict a lack of risk.

Anthropometric indicators of lack of risk were once presumed to be the same as those that predict risk, but recent work has revealed that this is not invariably the case. Studies have found that indicators of poor growth were less effective in predicting adequate growth than other indicators.

Achieving normative standards. Assessing achievement of normative standards requires indicators that reflect "normality."

Some activities appear to have no objectives beyond encouraging individuals to attain some norm. For instance, some have argued that moderate obesity among the elderly is not associated with poor health or increased risk of mortality, and if this were true, advocacy for the need for weight control in this age group would be based solely on normative distributions.

Research purposes that do not involve decisions affecting nutrition, health, or well-being. The indicator requirements for these objectives, whether they concern individuals or whole populations, are generally beyond the scope of this guide.

There may be differences in the interpretation of anthropometric indicators when applied to individuals or to populations. For example, while a reflective indicator, such as the presence of marasmus, signifies malnutrition in a given child today, a sudden increase of marasmus in a population may be predictive of future famine.

The appropriateness of indicators thus depends on the specific objectives of their use, and research is only just beginning to address this specificity and its implications. Little is known, for example, about how the use of different cut-offs for anthropometric indicators fulfills different objectives.

APPENDIX

Selecting a Sample 3.

Appendix adapted from Magnani (1997).

Sampling is the process that is used to select a representative *group* of *individuals whose characteristics can be described and used to* represent the whole population. The following section outlines a few of the problems that can result from incorrect sampling.

Sampling Error

A lot of thought should go into how to select the sample, and the following examples illustrate this.

Example: You are interested in doing a survey that will gather information on the prevalence of underweight children between 6 and 35 months and on the characteristics of their households. Each village that you will be conducting surveys in has a clinic where mothers and their children can be found on certain days of the week. The clinics already have scales, which would make them convenient. You decide to go to the clinics and measure all the children found there. Is this a good sampling plan for conducting your survey?

The answer is no. Mothers who go to the clinic are considered self-selecting. The mothers who decide to go to the clinic might have reasons for going that would make them different from mothers who do not go to the clinic. They might be more concerned with their child's health. Or they might be mothers who have sicker children. Or they might be mothers who do not have to work every day and therefore have the time to take their children to the clinic.

Any characteristic that makes an individual do something may also make them different from the population as a whole and have an effect on their children's nutritional status. When you have a sample that is made up of people who are not representative of the population for a certain reason, you have what is called sampling bias. This type of sampling error can happen when you select a sample from a group who all go to a specific place, but it can also happen if the sample is from one area of a village or a city or among people who are neighbors. These individuals may share some characteristic that makes them more similar to each other than to the larger population.

Here are some tips for avoiding this type of sampling error:

- Do not choose samples exclusively from particular groups, such as children coming to clinics.
- Do not ask mothers to bring their children to a central point in the community, because some of them will not come; you will not be able to find out how many failed to appear and how different they may be from those who came.
- Do not use samples chosen at will by the interviewer, field supervisor or field director.
- Do not restrict your sample to families living in easily accessible households, such as those close to a main road or near a village

center; families living in less accessible areas may be poorer and less healthy.

- Do not omit households where no one is at home the first time you call.

Sampling error can also happen if the sample size is not large enough.

Sample Size

Factors influencing sample size decisions

The sample size required for a given survey is determined by its measurement objectives. For surveys designed to either measure changes in indicators over time or differences in indicators between project and control areas, the required sample size for a given indicator for each survey round and/or comparison group depends upon five factors:

- how numerous the measurement units for the indicator are in the target population;
- the initial or "baseline" level of the indicator;
- the magnitude of change or comparison group differences on the indicator it is desired to be able to reliably measure;
- the degree of confidence with which it is desired to be certain that an observed change or comparison-group difference of the magnitude specified above would not have occurred by chance (that is, the level of statistical significance); and
- the degree of confidence with which it is desired to be certain of measuring an actual change or difference of the magnitude specified above will be detected (i.e., statistical power).

Note that the first two of these parameters are population characteristics, while the last three are chosen by the evaluator/ survey designer.

An example using changes in nutritional status

To illustrate how these parameters enter into the determination of sample size requirements, consider an evaluation where changes in indicators for the project area are being measured over time (i.e., a one-group pretest-post-test or reflexive design). For such an evaluation, the objectives for sample size determination purposes might be stated in terms of a key indicator as follows: *to be able to measure a decrease of **20 percentage points** in the proportion of children 6-59 months of age who are stunted with 95% confidence and 80% power.* Thus, if the estimated proportion of children who were stunted at the time of the baseline survey was 40%, the objective would be to measure a change in the prevalence of stunted children from 40% to 20% and be (1) 95% confident that a decline of this magnitude would not have occurred by chance; and (2) 80% confident of detecting such a decline if one actually occurred. The sample size calculations would answer the questions (1) how many children ages 6-59 months would be required to accomplish the above objectives; and (2) how many households would have to be chosen in order to find this number of children.

For evaluation designs involving comparisons between project and control areas, the objectives are framed in terms of the magnitude of differences between the two groups it is desired to be able to reliably detect. For example, in a reflexive evaluation design, sample size requirements might be set to detect a difference between project and control areas of 20 percentage points on a specified indicator. Similarly, when a pre- and post-test design with treatment and control areas is to be used, the sample size would be set to ensure that a difference in the degree of change on a key indicator between project and control areas of a specified magnitude (e.g., 20 percentage points) could be reliably detected.

Figure A3.1. Illustrative informational needs for determining sample size, generic Title II "health" indicators

A. Information on population composition:

1. Mean number of persons per household

2. Proportion of total population that are:
   a. Children under 0-59 months of age.
   b. Children under 24 months of age.
   c. Infants under 6 months of age.
   d. Infants between the ages of 6 and 10 months.

B. Information about "expected" levels or rates in the target population:
   1. Proportion of children aged 6-59 months who are stunted.
   2. Proportion of children aged 6-59 months who are underweight.

Steps involved in determining survey sample size requirements for a given survey

Calculating the number of sample elements required in order to satisfy the measurement requirements for a given indicator, and how many households would have to be contacted in order to find the number of elements needed in the first step.

For indicators expressed as proportions

The following formula may be used to calculate the required sample size for indicators expressed as a percentage or proportion. Note that the sample sizes obtained are for each survey round or each comparison group:

alpha = ∞ beta = β

$$n = D\,[(Z\infty + Z\beta)^2 * (P_1(1 - P_1) + P_2\,(1 - P_2)) / (P_2 - P_1)^2]$$

or n = D times [(Z alpha plus Z beta) squared times (P one times (1 minus P one) plus P two times (1 minus P two)) divided by (P two minus P one) squared]

Where:

n = required minimum sample size per survey round or comparison group;

D = design effect;

P_1 = P one, the estimated level of an indicator measured as a proportion at the time of the first survey or for the control area;

P_2 = P two, the expected level of the indicator either at some future date or for the project area such that the quantity ($P_2 - P_1$) is the size of the magnitude of change it is desired to be able to detect;

$Z\infty$ = Z alpha is the Z-score corresponding to the degree of confidence with which it is desired to be able to conclude that an observed change of size ($P_2 - P_1$) would not have occurred by chance; and

$Z\beta$ = Z beta is the Z-score corresponding to the degree of confidence with which it is desired to be certain of detecting a change of size ($P_2 - P_1$) if one actually occurred.

* Refers to a multiplication

Standards values of Z alpha ($Z\infty$) and Z beta ($Z\beta$) are provided in Figure A3.2, and the use of the above formula is illustrated in Figure A3.3. The different parameters in the formula are discussed on the next page.

Figure A3.2. Values of Z alpha (Z∞) and Z beta (Zß)

alpha ∞	One-tailed test	Two-tailed test	beta ß	Z beta Z_β
.90	1.282	1.645	.80	0.840
.95	1.645	1.960	.90	1.282
.975	1.960	2.240	.95	1.645
.99	2.326	2.576	.975	1.960
			.999	2.320

Figure A3.3. Illustrative sample size calculations for indicators expressed as proportions

Example 1

Suppose that it were desired to measure a decrease in the prevalence of underweight (weight-for-age) of 10 percentage points. At the time of the first survey, it is thought that about 40 percent of children between 12 and 36 months were underweight. Thus, $P_1 = .40$ and $P_2 = .30$. Using 'standard' parameters of 95 percent level of significance and 80 percent power, values from Figure A3.2 of alpha (∞) = 1.645 (for a one-tailed test - see below for further discussion) and beta (ß) = 0.840 are chosen. Inserting these values into the above formula, we obtain:

$$n = 2\,[(1.645 + 0.840)^2 * ((.3)(.7) + (.6)(.4))] / (.3 - .4)^2$$

$$= 2\,[(6.175 * 0.45)] / .01$$

$$= 2 * [2.77875] / .01 = 2\,(277.875) = 555.75$$

or 556 households per survey round.

Figure A3.4 provides a "lookup" table based upon the above formula to permit sample sizes to be chosen without having to perform calculations. The table provides sample sizes needed to measure changes/differences in a given indicator of specified magnitudes P two minus P one ($P_2 - P_1$) for different initial levels of the indicator (P_1). The table is for values of alpha (∞) = 0.95 and beta (ß) = 0.80.

Figure A3.4. Sample sizes required for selected combinations of P one (P_1) and changes or comparison-group differences to be detected (for alpha (∞) = .95 and beta (ß) = .80)

Change/difference to be detected ($P_2 - P_1$) (P two minus P one)

P one P_1	.05	.10	.15	.20	.25	.30
.10	1,075	309	152	93	63	45
.15	1,420	389	185	110	73	52
.20	1,176	457	213	124	81	56
.25	1,964	**513**	**235**	**134**	57	60
.30	2,161	**556**	**251**	**142**	90	62
.35	2,310	**587**	**262**	**147**	92	62
.40	2,408	**606**	**268**	**148**	92	62
.45	2,458	611	268	147	90	60
.50	2,458	606	262	142	87	56

Note: ample sizes shown assume a design effect of 2.0 and one-tailed tests. In a study of population-based cluster surveys to determine the design effects Katz (AJCN, 1995 Jan; 61(1):155-60) found the design effect range from 0.44 to 2.59. The use of D=2.0, therefore is conservative. For values of P one (P_1) greater than .50, use the value in the table that differs from .50 by the same amount. For example, for P one (P_1) = .60, use the value for P one (P_1) = .40; for P one (P_1) = .70, use the value for P one (P_1) = .30.

For indicators expressed as means or totals

For indicators that are means or totals, the following formula may be used to calculate sample size requirements for each survey round or comparison group:

$n = D\ [(Z\infty + Z\beta)^2 * (sd_1^2 + sd_2^2) / (X_2 - X_1)^2]$

(n equals D times [(Z alpha plus Z beta) squared times (sd one squared + sd two squared) divided (X two minus X one) squared]

Where:

n = required minimum sample size per survey round or comparison group;

D = design effect;

$Z\infty$ = Z alpha, the Z-score corresponding to the degree of confidence with which it is desired to be able to conclude that an observed change of size ($X_2 - X_1$) would not have occurred by chance;

$Z\beta$ = Z beta, the Z-score corresponding to the degree of confidence with which it is desired to be certain of detecting a change of size ($X_2 - X_1$) if one actually occurred;

sd_1 and sd_2 = "expected" standard deviations for the indicators for the respective survey rounds or comparison groups being compared;

X_1 = X one is the estimated level of an indicator at the time of the first survey or for the control area; and

X_2 = X two is the expected level of the indicator either at some future date or for the project area such that the quantity ($X_2 - X_1$) is the size of the magnitude of change or comparison-group differences it is desired to be able to detect.

The primary difficulty in using the above formula is that it requires information on the standard deviation of the indicator being used in the sample size computations. The preferred solution to this problem would be to use values from a prior survey that had been undertaken in the setting in which a program under evaluation is being carried out. If such data are not available, data from another part of the country or a neighboring country with similar characteristics may be used. Such data are often presented in survey reports.

APPENDIX 4.

Measuring Adults

The use of indicators of adult nutritional status for evaluating and monitoring USAID Title II development programs is limited. There is some experience with micronutrient status including anemia and Vitamin A and more with assessing body mass index for women. This section does not deal with obesity, micronutrient malnutrition or pregnancy. The information in this section refers to anthropometric assessment and is derived from various sources including FAO, WHO and the recent publication from the SCN, available from their website: acc.unsystem.org/scn/.

Adults are defined by WHO as those in the age range of 25-60 years although categories often extend from 20 years to 65 years of age. Adult anthropometrics have not been standardized in terms of reference data or choice of indicators for risk and response assessment as they have been for children. As noted in various sources, there is no recommended indicator or assessment approach for adult nutritional status. The assessment of adults older than 60 years presents a number of specific challenges not covered here. The reader is referred to the work of Help Age to deal with these assessments (Ismail, S., and M. Manandhar, 1999).

As with children, adult anthropometric assessment is used to reflect under-nutrition. Anthropometry is also used to reflect over nutrition but this is not the focus of this guide. Undernutrition in adults is characterized by patterns of acute and chronic deficiency of energy, protein and micronutrients including vitamins and minerals. Often a person is affected by both acute and chronic deficiency in all or some of the key nutrients. The manifestation of the deficiency and the measurement is therefore, complicated to determine and the functional significance unclear. Undernutrition is characterized by a lack of food and while specific nutrient deficiencies occur, such as pellagra due to a lack of niacin, the primary cause is more general. We are learning more about specific nutrient requirements for diseases such as HIV/AIDS but the ability of anthropometrics to identify these conditions is limited.

Adult anthropometric assessment is used for several purposes including:

- screening or targeting individuals for some sort of intervention or action such as supplementary feeding during famine relief;
- surveillance or monitoring of changes in prevalence and coverage in groups or populations to trigger a response including graduating from an intervention;
- evaluating the impact of activities or interventions.

Anthropometry is used to describe the nutritional situation in a population and this can be useful for problem analysis and for evaluation. Because the determinants of nutrition are so many, it is important to examine other factors than just anthropometry, such as the food security situation, levels of illness, care giving practices and so on.

For assessing women's nutrition status, usually, a combination of indicators is needed. Unlike children, reference data have not been standardized for women. For cross-sectional comparisons, reference data can be gathered from within the same population that the intervention group belongs to among healthy women, women with positive pregnancy outcomes. Construction of an adult nutrition reference has been done for some populations.

Each anthropometric indicator listed for adults and especially for women has its own advantages and limitations. To determine the best indicator, one should consider the objectives of the nutrition program and its associated reporting requirements. Several possible uses of indicators are:

4.1. Height

Adults are not growing in stature. Height in adults is determined by a person's genetic potential and the health and nutrition experiences dating back to the fetus. Most growth in height is completed by age 17 with some incremental growth for another 10 years. Height, therefore, may be useful for a reflection of past events and be used in some screening situations, but will not be able to reflect recent or current nutritional shocks or change. Women's height is a useful predictor of pregnancy outcomes such as low birth weight and possible delivery complications; thus it is an indicator of risk. Because height will change very little among adult women, it is not useful for evaluating interventions (outcome). Height can not be used for monitoring and evaluation of programs.

Adult Measuring Device (Microtoise) (UNICEF No. 0114400 Height measuring instrument (0-2 m)): This lightweight portable tape is wall mounted and fits easily into the package needed for field measurements. Made of plastic, the Microtoise measures up to 2 meters and is available for approximately US$20. For more information contact: UNICEF Supply Division; UNICEF Plads, Freeport; DK-2100 Copenhagen, Denmark; Telephone: (45) 35 27 35 27; Fax: (45) 35 26 94 21; Email: supply@unicef.org; Website: www.supply.unicef.dk. Or contact UNICEF field office: www.unicef.org/uwwide/fo.htm (use Internet Explorer).

Adult Measuring Device: An inexpensive height measuring device useful for children over 24 months and adults is the Harpenden pocket stadiometer (range 0-2m) available from CMS weighing equipment. The cost is approximately US$100. CMS Weighing Equipment, Ltd.; 18 Camden High Street; London NW1 OJH, U.K.; Telephone: 01 387 2060; (44) 020 7383 7030.

4.2. Weight

Weight does change reflecting recent events. For monitoring change in an individual, weight change is helpful, as height would not be expected to change. For controlled studies where the same participants are being followed and height would not be changing, weight can be used for screening and evaluation purposes. More than one measurement is necessary for tracking changes.

For women who are pregnant, weight gains of 1.5 kg/month during the last two trimesters are consistent with positive pregnancy outcomes in developing countries. Short maternal stature, low pregnant body mass index (BMI) and poor weight gain during pregnancy are all indicators of risk for low birth weight. As stated above, not all of these are indicators of outcome.

For comparing within or across groups, an interpretation of weight change needs to be done controlling for the variation in height. The most common indicator used to control for height and to reflect body mass is referred to as the body mass index (BMI). There are limitations in the use of this indicator.

Scales are used to weigh adults and can be obtained from various sources. Ensure the scale is sturdy, reliable and accurate.

UNICEF Electronic Scale: (Item No. 0141015 Scale mother/child, electronic) The scale is manufactured by SECA and is a floor scale for weighing children as well as adults (capacity 150 kg). Weighing capacity from 1 kg to 150 kg in 100 g divisions, accuracy +/- 100 g. Weight of adult on scale can be stored (tared) in memory, allowing the weight of baby or small child held by adult to show on scale indicator. The portable scale, weighing 4 kg, includes a solar cell on-switch (light sensitivity 15 lux) and is powered by a long-life lithium battery good for one million weighing cycles. Instructions are available in English, French and Spanish.

The major advantage is that it has a micro-computer chip so that it can adjust itself to zero and weighs people quickly and accurately. The child may be weighed directly, if possible. If a child is frightened, the mother can first be weighed alone and then weighed while holding the child in her arms, and the scale will automatically compute the child's weight by subtraction. Recent experience in surveys suggests that the scale is appropriate for Cooperating Sponsor use although some difficulty has been experienced with heat adversely affecting the scale. The price of this scale is US$90 and it can be ordered from UNICEF's Supply Division in Copenhagen through any UNICEF field office. www.supply.unicef.dk/catalogue/index.htm (use Internet Explorer).

BMI is based on a weight-to-height ratio that is considered a good index of body fat and protein stores. Body stores are of interest because they reflect the stores needed to cope with physiological stress due to reduced intake and increased demands due to increased activity, pregnancy and diseases. Adults who have a healthy nutritional status would be expected to have body stores or BMI within a certain range. BMI, also known as "Quetelet's index," is summarized below:

Body mass index (BMI) = weight/(height)^2

The formula for BMI is the weight (in kilograms) divided by the height (in meters) squared. A woman who weighs 55.5 kgs and a height of 162.5 cm would have a BMI of (55.5/(1.625 x 1.625)) = 20.9.

It is best used for individuals between the ages of 20 and 65 years.

While no standard classification system exists, the following was recommended by Collins et al. (2000) for chronically undernourished populations.

Table A4.1. Body Mass Index Categories of Chronic Undernutrition

Normal	>= 18.5
Grade I	17.0 – 18.49
Grade II	16.0 – 16.99
Grade III	< 16

While these categories are suggested, there is difficulty of using these categories to compare across populations due to 1) a lack of understanding of the functional significance of these categories; and 2) the influence of body shape to interpreting BMI.

Body shape, especially the size of the trunk in relation to the leg length influences both the BMI and the interpretation of the result. A long wasted – short legged individual will have a higher BMI for the same overall height as someone with especially long legs. Body shape can be reflected in the ratio of sitting height (reflecting the trunk length) to the standing height (reflecting the leg length). Referred to as the Cormic Index (sitting height to standing height, expressed as a percentage – SH/S), this index can correct for differences in BMI in ethnically diverse populations. The SH/S index should be expressed as a percentage.

The SH/S percentage can be measured using the standing height (H) (see above) and the sitting height (SH) measured by the person sitting upright in a chair either in a measuring board used for children (refer to Part 4) or the adult measuring devices discussed above.

The correction from Collins et al. (2000) for standardizing BMI using the Cormic Index (SH/S percentage) applies the following formula:

Male **BMI = 0.78 (SH/S) – 18.43**
Female **BMI = 1.19 (SH/S) – 40.34**

The reader is referred to Collins et al. (2000) for the use of the Cormic Index for comparing across population groups where an average for the Cormic Index can be used. For individuals, their own Cormic Index should be used to correct the BMI.

BMI changes during pregnancy. It will be necessary to separate pregnant women from non-pregnant women when comparing BMI.

In summary:

- For comparisons within populations over relative short times for evaluation purposes, BMI should **not** require a correction using the Cormic Index.
- Assessing or screening individuals for targeting using BMI should correct the individuals BMI using the Cormic Index for that individual.

The authors of the SCN review (Collins et al. 2000) conclude that in situations of emergency screening, the measurement of height and sitting height and the use of the Cormic Index correction is time consuming and mostly unrealistic. In situations of famine relief, they caution that without the standardization with the Cormic Index, the use of BMI alone for screening is inappropriate. BMI measured during emergency situations requires good equipment, well-trained personnel and an ability to convert the measures into the BMI. Challenges in measuring people who are very sick, elderly and disabled may make the use of BMI for screening even more difficult.

In addition to a Cormic Index correction, the age distribution is important. As people grow older, the distribution of fat and fat free mass (water, bone and muscle) changes. For screening purposes, BMI may have to be adjusted for age. There is no guidance for this at the moment. For evaluation purposes, as long as the distribution of age in the baseline and follow up remain the same, the biases will be consistent and age should not confound the analysis of change. Where age is a potential confounding variable, data may have to be presented for age group which has assessment implications (not all respondents know their ages) and sample size estimations (stratification of the sample increases size requirements).

4.3. Mid-upper arm circumference (MUAC)

MUAC is the circumference of the left upper arm measured in centimeters. The point is between the tip of the shoulder and the elbow. The use of MUAC and the equipment for the measurement is detailed in Part 5 of this Guide. Arm circumference is measured with special circumference measuring tapes or circumference insertion tapes.

Because the equipment is lightweight and training to do MUAC is straightforward, MUAC is utilized for screening in emergency situations when nutritional status information is needed immediately for large groups of people, especially children. The indicator is useful for assessing acute adult undernutrition and for assessing the prevalence of undernutrition at the population level.

While arm circumference measures both muscle and fat, some populations would be expected to have very little subcutaneous fat on their arms. A low or decreasing arm circumference for these populations would signal the loss of muscle mass, a serious sign, possibly indicative of protein-energy malnutrition or starvation. MUAC is usually unaffected by edema common in famine, and is a sensitive reflection of tissue loss and is independent of height.

The use of MUAC for emergency program screening has limitations. The choice of cut-offs is challenging as there is a lack of an understanding of the functional significance of different levels.

Collins et al. (2000) recommends the following MUAC cutoffs for screening adult admissions to feeding centers.

Table A4.2. MUAC cutoffs for Screening Moderate and Acute Adult Undernutrition

Level of undernutrition	MUAC (cm)
Moderate	<18.5
Severe	<16.0

MUAC is independent of pregnancy or lactation status and therefore can be used as an effective indicator of women's nutritional status throughout the reproductive years. MUAC is more useful than weight during pregnancy, as it varies little during pregnancy. One consideration to take when using MUAC to determine women's nutritional status is the age structure of the community because MUAC increases with maternal age. Cut-offs for MUAC can fluctuate between ethnic groups, therefore local references may need to be established. It is suggested to report change in mean MUAC over time rather than use a ill-defined cut-off.

4.4. Skinfold thickness

Skinfold thickness and arm circumference are two measurements that indirectly assess two important components of a body: fat and fat-free mass. The reason that measuring these components is important is that fat is the main storage form of energy and fat-free mass, usually muscle, is a good indicator of the protein reserves of a body.

Skinfold thickness measures fat located just underneath the skin (subcutaneous fat), which is a proxy indicator of total body fat. Measurements can be done in a number of sites, including: the triceps (the back of the upper arm); the biceps (the front of the upper arm); and the subscapular area (the site just below the shoulder blade). The tool that measures skinfold thickness is called skinfold thickness calipers. Use of skinfold thickness calipers requires specialized training and supervision to ensure accurate and precise measurements. It is not recommended for use in Title II monitoring and evaluation.

Elderly Anthropometric Assessment

Elderly is defined by WHO as those 60 years old and over. Height measurement in older people can be problematic. Accurate measurements may not be possible if the person cannot stand completely erect.

Assessment techniques and cut-offs for elderly do not differ from those used for adult assessment. Assessing response to an intervention is possible by comparing change in BMI over time. As with adults, reference standards can be developed locally. All elderly assessments should note the difficulty and lack of precision inherent in elderly anthropometrics (Ismail and Manandhar, 1999).

Adolescent Anthropometric Indicators

APPENDIX 5.

Adolescents are defined by WHO as those in the age range of 10 to 19 years. The nutritional status of this age group is difficult to assess because there is not a reference standard for adolescents and there is a growth spurt which occurs with puberty which occurs at different ages. This limits the ability to use a reference standard even if it is developed locally. The United Nation's Standing Committee on Nutrition (SCN) has produced a paper, *Adolescents: Assessment of Nutritional Status in Emergency-Affected Populations,* on assessing nutrition status for emergency-affected populations (Woodruff and Duffield,. SCN: Geneva, 2000). This paper can be found at http://acc.unsystem.org/scn.

The SCN recommends that due to a lack of validated anthropometric procedures for adolescents, anthro-pometry is not used without examining other population sub-groups and other determinants of nutrition and food security.

As with children, adolescent anthropometric assessment is used to reflect undernutrition. Anthropometry is also used to reflect over nutrition but this is not the focus of this guide. Undernutrition in adolescents is characterized by patterns of acute and chronic deficiency of energy, protein and micronutrients including vitamins and minerals. Often a person is affected by both acute and chronic deficiency in all or some of the key nutrients. The manifestation of the deficiency and the measurement is complicated to determine and the functional significance unclear. Undernutrition is characterized by a lack of food and while specific nutrient deficiencies occur, such as pellagra due to a lack of niacin, the primary cause is more general. We are learning more about specific nutrient requirements for diseases such as HIV/AIDS but the ability of anthropometrics to identify these conditions is limited.

As with adults, adolescent anthropometric assessment is used for several purposes including:

- screening or targeting individuals for some sort of intervention or action such as supplementary feeding during famine relief;
- surveillance or monitoring of changes in prevalence and coverage in groups or populations to trigger a response including graduating from an intervention; and
- evaluating the impact of activities or interventions.

Anthropometry is used to describe the nutritional situation in a population and this can be useful for problem analysis and for evaluation. Because the determinants of nutrition are so many, it is important to examine other factors than just anthropometry such as the food security situation, levels of illness, care giving practices and so on.

There are a number of recommendations for different purposes. The reader is cautioned that some of the recommendations (including WHO) are being questioned (see Woodruff and

Duffield, 2000). The complex physiological changes, pubertal development, inter-ethnic differences in genetic growth potential, and the different determinants of body size and shape makes rigid recommendations difficult.

The recommendations for emergency screening should be for indicators that are easy to measure and do not require cumbersome or complicated equipment and procedures. The indicator should be determined taking into account differences between the survey and reference populations in age, sexual development and ethnicity. Most commonly found measurements in emergency situations are weight, height and mid-upper-arm-circumference (MUAC). Measuring height can be challenging especially in emergency situations and for severely malnourished people who are feeble and disabled, height measurement may be impossible. The presence of famine edema is a serious indicator of nutritional stress and the accumulation of fluid distorts weight measures. Any situation of edema would be an indication for a range of nutrition interventions.

For targeting interventions and assessing the situation, thinness measures are recommended. Thinness can be reflected by percent median weight-for-height or BMI-for-age and the Rohrer Index. Thinness is especially of concern among those adolescents who have not yet finished their growth spurt. Pregnancy adds weight to the girl and will distort the various weight based measures. During pregnancy, measures of weight change and MUAC are recommended.

For assessing response to an intervention for adolescents, BMI should be used for programs designed to reduce the prevalence of thinness. BMI can be compared to local reference data or changes from pre- and post-intervention can be compared.

It should be stressed that there is a lack of data to relate the specific indicator and its cut-off with health or survival outcomes. This means that to define undernutrition in adolescents, we do not have evidence of the choice of indicator or cutoff that exists with children under the age of 5 years. Weight-for-height and BMI indicators need to be examined based on an accurate determination of age. This may not be possible in many situations where age is unknown.

The SCN recommend that clinical criteria be used for screening for therapeutic feeding. Surveys, they suggest, should correct for different ages of sexual maturation if the age of maturation in the survey population differs from the reference population. This is likely if the reference population is from a developed country.

The recommendation for screening in Pre-Pubertal Adolescents, is to use weight-for-height as the index of choice (using weight-for-height reference standards).

For Post-Pubertal Adolescents, BMI should be used and compared with the international reference standards.

Height-for-age The measure for height for estimating stunting during adolescence is the same as it is for young children. Stunting reflects chronic malnutrition. The height is compared to the height of adolescents of the same sex and age in the NCHS reference population. Growth charts for the US are available at: www.cdc.gov/growthcharts/. The cut off of <-2 Z-scores is also used. This measure is limited because height varies much more among healthy adolescents than it does for preadolescent children, making it difficult to establish reliable benchmarks. Locally defined cut-offs can provide greater accuracy.

Weight-for-height is problematic because at a given height, the median weight differs depending on age. This does not allow analysis of weight-for-height across wide age categories.

BMI is the foundation of accurate anthropometric assessment for adolescents. However, without age, BMI data are quite limited for adolescents.

BMI-for-age Median and less than median BMI-for-age varies little among well nourished populations. High percentage BMI at any age has shown variations and is a less accurate indicator for overweight assessment. BMI-for-age is also inaccurate for stunted individuals.

Cut-off values are not well tested for assessing risk and response to interventions. Local reference standards should be developed. Growth charts for the US are available at www.cdc.gov/growthcharts/ but the SCN cautions on the use of these reference standards. It should be noted that BMI-for-age is not a straightforward concept and has not been examined for its ability to predict outcomes among malnourished adolescents.

Rohrer Index (weight/height^3) is calculated as the weight in kilograms divided by height in meters cubed. An adolescent girl weight 24.4 kilograms and is 132.3 cm tall would have a Rohrer Index of 10.5. There is some evidence that the Rohrer Index is less age dependent and can be used like BMI. There are no reference standards for the use of this index.

Percent median weight-for-height In the absence of strong, simple adolescent indicators, recommendations are to use percent of the median weight-for-height. Using weight-for-height has the limitation being an indicator of current or acute malnutrition. Because of its response to short-term influences, wasting is not used to evaluate Title II programs but may be used for screening or targeting purposes and is sometimes used for annual reporting.

Mid-upper arm circumference (MUAC) is the circumference of the left upper arm measured in centimeters. The point is between the tip of the shoulder and the elbow. The use of MUAC and the equipment for the measurement is detailed in Part 5 of this Guide. Arm circumference is measured with special circumference measuring tapes or circumference insertion tapes.

Because the equipment is lightweight and training to do MUAC is straightforward, MUAC is utilized for screening in emergency situations when nutritional status information is needed immediately for large groups of people, especially children. The indicator is useful for assessing acute adult undernutrition and for assessing the prevalence of undernutrition at the population level.

While arm circumference measures both muscle and fat, some populations would be expected to have very little subcutaneous fat on their arms. A low or decreasing arm circumference for these populations would signal the loss of muscle mass, a serious sign, possibly indicative of protein-energy malnutrition or starvation. MUAC is usually unaffected by edema common in famine and is a sensitive reflection of tissue loss and is independent of height.

The use of MUAC for emergency program screening has limitations. The choice of cut-offs is challenging as there is a lack of an understanding of the functional significance of different levels. No reference standards exist for MUAC. Careful training is required to ensure that the correct location is identified on the arm. This is especially important with rapidly growing adolescents. It is suggested that MUAC be presented by age category and sex.

There are no recommended MUAC cut-offs for determining adolescent undernutrition or for admissions to feeding centers.

APPENDIX 6.

Standardization of Anthropometric Measurements

Appendix adapted from WHO (1983).

The training of personnel on specific measurement and recording techniques includes not only theoretical explanations and demonstrations, but also an opportunity to allow participants to practice the measurement techniques, as well as reading and recording the results. This practice is more efficient when a large number of children are available.

Once all personnel have adequately practiced the measurement and recording techniques, and feel comfortable with their performance, standardization exercises can be carried out. Each exercise is performed with a group of 10 children whose ages fall within the pre-established range for the study. A sequential identification number is assigned to both children and staff. To conduct the exercises the following are needed:

- balances/scales and height boards;
- pens; and
- sufficient Anthropometric Standardization Forms 1 and 2, to record the exercise number, name and number of the measurer, date on which the exercise is conducted, and a sequential listing of children with their name, age and identification number.

Form 1. Formula for Anthropometric Standardization

Weight

Exercise number: ______________________

Name of measurer: ______________________

Measurer's code: ______________________

Date ___ / ___ / 2000

Name	Age in months	No.	My measure	Standard measure	Difference sign (+ , -)
		1			
		2			
		3			
		4			
		5			
		6			
		7			
		8			
		9			
		10			

Number of large differences	**(0.3 Kg or more)**	**Whole circles**	**1** ________
Number of medium differences	**(0.2 Kg)**	**Empty circles**	**2** ________
Number of small differences	**(0.0 or 0.1 Kg)**	**Without circles**	**3** ________

= ________ ________

Form 2. Formula for Anthropometric Standardization

Height

Exercise number: ______________________________

Name of measurer: ______________________________

Measurer's code: ______________________________

Date ___ / ___ / 2000

Name	Age in months	No.	My measure	Standard measure	Difference sign (+ , -)
		1			
		2			
		3			
		4			
		5			
		6			
		7			
		8			
		9			
		10			

Number of large differences	(1.0cm or more)	Whole circles	1 ________
Number of medium differences	(0.6-0.9cm)	Empty circles	2 ________
Number of small differences	(0-0.5cm)	Without circles	3 ________

No. DIFS. Sign (+): ________ No. DIFS. Sign (-): ________ = ________ ________

Measurement and Recording

Before carrying out the exercise, the supervisor carefully weighs and measures each child and records the results without any of the trainees seeing the results. For each exercise, a group of up to 10 measurers will conduct the measurements in a pre-determined order. Each child will remain at a fixed location. The distance between each child should be big enough to prevent measurers seeing/ hearing each others results.

At the beginning of an exercise, each measurer and assistant is paired with a child. Once the children and the measurers have been positioned with their respective materials and instruments, the supervisors should instruct the measurers to begin the measurements following the pre-established sequence. The measurer carefully conducts the measurements and clearly records in ink the results on the anthropometric standardization form (MY MEASURE column) next to the child's identification number. The measurers remain with the child until the supervisor instructs them to move. Once results are recorded, corrections are not allowed. When all the measurers have conducted their measurements, the supervisor should instruct them to move to next child following the numerical order and requests that they wait for instructions to begin the measurement. This process is repeated until all children have been weighed and measured by all the measurers.

Use the same equipment to measure each child's weight and stature. Measurers and assistants should rotate to conduct the measurement, but the equipment remains stationed next to each child. Only one pair of measurers should be with a child at any one time. Talking between measurer-pairs during this exercise is not allowed.

The supervisor should take advantage of the standardization exercises to systematically observe each measurer's performance using the Measurement Techniques Observation Form 3. This form contains a list of the most important steps of each measurement technique, that allows the supervisor to record if each step was completed appropriately, and to later discuss the results of these observations with the staff.

Form 3. Measurement techniques observation

Weight

Observer #		1		2		3		4	
	Exercises	1	2	1	2	1	2	1	2
1	Position of equipment								
2	Adjustment to zero								
3	Clothes								
4	Child's attitude								
5	Child's position								
6	Reading time								
7	Reading angle								
8	Reading								
9	Value								
10									
11									
12									
13									
14									
VALUE	Observer								
	Supervisor								
	Difference								

Height

Observer #		1		2		3		4	
	Exercises	1	2	1	2	1	2	1	2
1	Position of equipment								
2	Adjustment to zero								
3	Clothes								
4	Child's attitude								
5	Child's position								
6	Reading time								
7	Reading angle								
8	Reading								
9	Value								
10									
11									
12									
13									
14									
VALUE	Observer								
	Supervisor								
	Difference								

Form 4. Example of overplacing of forms to compare measurers

Height

Standardization of Anthropometrics Weight				Exercise #1	Exercise #1	Exercise #1	Exercise #1
				Measurer A	Measurer B	Measurer C	Measurer D
Name of measurer							
Age in months	#	Measurement A	Standard Measurement B	Difference A - B sign (+ , -)	Difference A - B sign (+ , -)	Difference A - B sign (+ , -)	Difference A - B sign (+ , -)
	1	___ ___ . ___	___ ___ . ___	( ) ___ . ___	( ) ___ . ___	( ) ___ . ___	( ) ___ . ___
	2	___ ___ . ___	___ ___ . ___	( ) ___ . ___	( ) ___ . ___	( ) ___ . ___	( ) ___ . ___
	3	___ ___ . ___	___ ___ . ___	( ) ___ . ___	( ) ___ . ___	( ) ___ . ___	( ) ___ . ___
	4	___ ___ . ___	___ ___ . ___	( ) ___ . ___	( ) ___ . ___	( ) ___ . ___	( ) ___ . ___
	5	___ ___ . ___	___ ___ . ___	( ) ___ . ___	( ) ___ . ___	( ) ___ . ___	( ) ___ . ___
	6	___ ___ . ___	___ ___ . ___	( ) ___ . ___	( ) ___ . ___	( ) ___ . ___	( ) ___ . ___
	7	___ ___ . ___	___ ___ . ___	( ) ___ . ___	( ) ___ . ___	( ) ___ . ___	( ) ___ . ___
	8	___ ___ . ___	___ ___ . ___	( ) ___ . ___	( ) ___ . ___	( ) ___ . ___	( ) ___ . ___
	9	___ ___ . ___	___ ___ . ___	( ) ___ . ___	( ) ___ . ___	( ) ___ . ___	( ) ___ . ___
	10	___ ___ . ___	___ ___ . ___	( ) ___ . ___	( ) ___ . ___	( ) ___ . ___	( ) ___ . ___
Large differences (1.0 or more) = whole circles				**1** ________	Total	Total	Total
Medium differences (0.6 or 0.9cm) = empty circles				**2** ________	Total	Total	Total
Small differences (0.5 or less) = no circles				**3** ________	Total	Total	Total
# of diffs. sign + ______ **LESS** # of diffs. sign - ______ = ( ) ____					( ) ________	( ) ________	( ) ________

Form 5. Tracking measurer's progress

Name of measurer-pair ____________________

No. ____________________

Name of supervisor ____________________

Name of supervisor ____________________

	Height				Weight			
Result exercise No. #								
Date								
Number of full circles								
Number of empty circles								
Number without circles								
Total markings								

Name of measurer-pair ____________________

No. ____________________

Name of supervisor ____________________

Name of supervisor ____________________

	Height				Weight			
Result exercise No. #								
Date								
Number of full circles								
Number of empty circles								
Number without circles								
Total markings								

Analysis

Once all the children have been measured by all the measurer-pairs, the supervisor should meet with the group to analyze the results of the exercise and the measurers read out-loud the results of his/her measurements for each child. The measurers should record these results in their respective forms, under the STANDARD MEASURE column (see Forms 1 and 2). Next, each of the measurers should calculate the difference between MY MEASURE and STANDARD MEASURE for each measurement and child, and record the result on the same form under the DIFFERENCE column, using the corresponding + or - sign: if the measurer's measurement is larger than the supervisor's measurement (standard measurement), the sign is positive; if the measurer's measurement is lower than the supervisor's measurement, the sign is negative. Following this procedure, the measurers should draw a circle to the right of the large and medium differences as follows:

Measurement	Whole Circle	No Circle
Empty Circle		
Child's weight 0.3 kg or more	0.2 kg	< 0.2 kg
Child's length /height 1.0 cm or more	0.6 to 0.9 cm	< 0.6 cm

Each measurer then totals the number of large differences (marked with a whole circle) and the number of medium differences (marked with an empty circle), and records the totals in the corresponding boxes on the lower part of the form (box 1 for large differences and box 2 for medium differences). The sum of all small differences or no differences should be calculated and recorded in box 3.

Finally, the difference between the number of positive and negative differences (excluding zeros) should be calculated and recorded in the big box on the form with its corresponding sign. For example, if there are 6 positive differences, 3 negative differences, and a zero, the result is +3; if there are 8 negative differences and 2 positive differences, the result is -6.

Interpretation

The interpretation of the standardization exercise results is made by the measurers with the supervisor's help. The purpose is to detect differences, identify their possible causes, and correct them. To achieve this, it is important to take into account the size of the differences between each measurer and the supervisor, as well as the positive or negative sign of the differences.

1. Size of the differences

The total number of the differences, according to their size, has already been recorded by line 1, 2, and 3 located in at the bottom of the form as follows: large differences in line 1, medium ones in line 2, and small differences (including the absence of differences) in line 3. As the number of differences in lines 1 and 2 decreases, especially in line 1, the agreement between the measurer and the supervisor increases; that is, the better the standardization of the measurer with the supervisor. Large differences (line 1) generally indicate carelessness in the reading or recording, or serious problems in the measurement technique. Moderate differences usually indicate problems in the measurement technique. The ideal is to obtain the largest number in line 3 (small differences or complete agreement).

In cases where large or medium differences are found, the respective measurer with the assistance of the supervisor should carefully repeat the measurement in order to identify and correct the cause of the differences.

2. Sign of the differences

If the total registered in the big box is +6 or more, the measurer's measurements are consistently larger than the supervisor's. For weight measurements, the most frequent causes for differences are: not adjusting the scale to zero at the beginning; reading the scale in an oblique position and not facing the scale; or reading the scale by following the incorrect direction. In height or length measurements, the most frequent causes for differences are: inadequate position of the head or feet; a reading done in an oblique position and not facing the reading point of the measuring board or height-measuring apparatus; or a reading conducted by following the incorrect direction of the scale.

If the total in the big box is -6 or less (for example, -8), the measurer's measurements are consistently smaller than the supervisor's measurements. With weight measurements, the most frequent causes for differences are similar to those described above for consistently large measurements. With height or length measurements the most frequent causes are similar to those described above for consistently large measurements, in addition to flexing of the child's legs during measurement.

In all cases in which large or medium differences are found, the respective measurer with the assistance of the supervisor should carefully repeat the measurement in order to identify and correct the cause of the differences.

3. Sample exercise with 4 measurers

	Measurers			
	A	B	C	D
Large differences (line 1)	1	2	0	0
Medium differences (line 2)	4	0	2	8
Small differences (line 3)	5	8	8	2
Signs exercise (final box)	+2	-5	+6	-6

Possible interpretation:

Measurer A
Careless measurement (reading or recording) and problems with the measurement technique.

Measurer B
Careless measurement, but no evident problems with the measurement technique.

Measurer C
Generally well done (1 to 2 moderate differences may be allowed), but the sign test gives +6.

Measurer D
Problems are evident with the measurement technique and the sign test gives -6.

4. Comparison between measurers
The forms used in the exercise for each anthropometric pattern can be overlapped so that comparisons can be made between measurers (see Form 4 for example of weight measurements). A summary table that shows progress made by the measurer-pairs can also be prepared (Form 5). If the frequency, magnitude, and sign of the differences with the supervisor are similar for 2 or more measurers, this can suggest that they may have common problems. If the differences concentrate in the measurements of 1 or 2 particular children, all the measurers in conjunction with the supervisor should repeat the measurements for these children, in order to identify and correct any problems. In some cases problems can be the result of children who move too much and are difficult to measure.

Replication of the Exercises

The exercises should be repeated as many times as necessary until none of the measurers have large differences (line 1), and a maximum of 1 or 2 medium differences (ideally zero) and until the tendency to obtain larger or smaller values than those of the supervisor disappears (less than 6 in the big box). Generally, this is accomplished after 2 or 3 exercises for weight and height. The progress made by the measurers during the standardization exercises can be observed using Form 5.

Figure A6.1 Recording Measurements

1. Place numbers in appropriate boxes for the measurements. Be careful to make clear and neat numbers the same way every time. The following is a suggested way of writing numbers.

   1 2 3 4 5 6 7 8 9 Ø

2. Notes:

   1 : A single vertical line. Do not slant the 1 (/). Do not put a 'hat' or base on the 1 (1 , 1).

   2, 3 : Make 2 and 3 with no loops (2 2 3 3).

   4 : Make open 4's. Closed 4's can look like 9's (4).

   5 : Be careful not to connect the 5 which can look like a 6 (5).

   6 : Be careful with the loop of the 6 which can look like a zero (6).

   7 : Cross the 7. This way it will not look like a 1 (7 : 1 or 7?).

   8 : Make with two separate loops. 'Figure-eight' 8's can look like 0 (8). Be careful not to separate the two loops (8).

   9 : Make sure to close the loop of the 9 which could look like a 4 (9 : a 9 or a 4?).

   Ø : Put a diagonal line through zeros for easy identification. Zeros can look like the number 6 (6 : a 0 or 6?).

3. Make sure you place numbers inside the boundaries of the box on a questionnaire.

Incorrect	Correct
24.7	24.7

4. Number single digits 1-9 as follows: | Ø | 8 | or | Ø | Ø | 8 |

5. Fill in all boxes. Make sure to put numbers, including zeros, in the correct boxes. Example: Child height is 92.0 cm.

Incorrect	*Incorrect*	*Incorrect*	Correct
[ ][9][2].[ ]	[ ][9][2].[Ø]	[9][2][Ø].[ ]	[Ø][9][2].[Ø]

6. Use pencil only. If you make a mistake, completely erase the mistake; then rewrite the correct numbers.

Guidelines for Supervising Surveys

APPENDIX 7.

In order to facilitate the supervision required for quality control of anthropometric data, this guide describes the procedures that supervisors need to follow to routinely conduct quality control on field data.

Focus and Content of Supervision

Supervision should have a focus on guidance and training and not be seen as policing. In other words, reinforcing training and motivating staff to guarantee good quality data is essential. From a quality control perspective, supervision includes two basic activities:

1. Direct **observation** of the measurement techniques conducted by the measurers. The supervisor routinely observes the performance of the measurers while they weigh and measure throughout the entire data collection process. To do this, the supervisor should make a list of the most important steps that need to be systematically observed, or a form similar to the one used during the training and standardization (Form 5), which contains a column to record whether each step was correctly followed.

2. **Replication** of measurements in 10 percent of the sample. The supervisor should repeat the measurements conducted by the measures in 10 percent of the children (one out of every ten), preferably on different days and in a random fashion so that the measurers will not know which children's measurements will be repeated. The supervisor records the results of these repeated measurements on the regular data collection forms, compares these results with the ones conducted by the respective measurer and, if discrepancies are found, discusses the results with the measurer so as to identify the causes and correct them.

Through observation of the measurers and a careful review of results of the replications, the supervisor can reinforce measurer training and correct any faults. The standardization exercises should be repeated whenever needed.

Quality Control Through Visual Inspection of the Forms

The supervisor will, on a daily basis and in a systematic way, visually inspect the forms where the data are recorded. The purpose of this inspection is to detect missing data, inconsistencies, recording errors and values outside the pre-established permissible ranges.

During the review, emphasis should be given to the following points:

1. Date of measurement
2. Correct identification of the form with the mother or infant's identification number, as well as the correct sex of the child
3. Date of birth of the child
4. Weight of the child
5. Length/height of the child

Points 1 to 3 are especially important to detect errors in identification. These errors should be immediately corrected. The anthropometric data (4 and 5) are reviewed with the goal of detecting errors in recording (coding) and values outside the preestablished range, as follows:

For the child's weight, values falling outside the following ranges according to age.

Age (months)	Range of Weights (Kg)
6 - 11	4.00 - 13.00
12 - 17	7.00 - 15.00
18 - 23	8.00 - 16.50
24 - 29	8.50 - 17.50
30 - 35	9.00 - 19.00
36 - 41	9.50 - 22.15
42 - 47	10.00 - 23.00
48 - 53	11.00 - 24.50
54 - 59	11.50 - 26.00
60 - 65	12.00 - 27.50
66 - 71	13.00 - 29.50
72 - 77	13.50 - 31.50
78 - 83	14.00 - 33.50

Age (months)	Range of Length/heights (cm)
6 - 11	60 - 90
12 - 17	65 - 95
18 - 23	70 - 100
24 - 29	75 - 105
30 - 35	80 - 110
36 - 41	80 - 115
42 - 47	85 - 115
48 - 53	90 - 120
54 - 59	90 - 125
60 - 65	95 - 130
66 - 71	95 - 130
72 - 77	100 - 135
78 - 83	100 - 140

Values outside the ranges should be carefully reviewed by both the supervisor and the measurers with the aim of assuring that there were no errors in measurement or recording. In cases of doubt, the measurement should be repeated; if this is not possible the data should be erased and replaced with the code "999" for the weight or "9999" for height. If it is confirmed that the data are correct, they are kept even though they may be outside the range.

Once the coding has been visually inspected, data are entered into the computer. Data processing procedures for quality control will also be applied to detect possible coding errors, inconsistencies, and data outside the specified ranges. It is important to emphasize, however, that quality control in the field through supervision, including the daily and routine inspection of forms, is the only efficient procedure to detect and correct errors, omissions, and inconsistencies in a timely manner. The feasibility of correcting errors during data processing is much lower given that generally it is too late to return to the primary source of the data, the majority of errors detected at that late time cannot be corrected and many of them end up as missing data.

Title II Generic Indicators

APPENDIX 8.

The Title II Generic Indicators

Category	Level	Indicator
Health, nutrition and MCH	Impact	% stunted children 24-59 months (height/age Z-score)
		% underweight children by age group (weight/age Z-score)
		% infants breastfed w/in 8 hours of birth
		% infants under 6 months breastfed only
		% infants 6-10 months fed complementary foods
		% infants continuously fed during diarrhea
		% infants fed extra food for 2 weeks after diarrhea
	Annual monitoring	% eligible children in growth monitoring/promotion
		% children immunized for measles at 12 months
		% of communities with community health organization
		% children in growth promotion program gaining weight in past 3 months (by gender)
Water and Sanitation	Impact	% infants with diarrhea in last two weeks
		liters of household water use per person
		% population with proper hand washing behavior
		% households with access to adequate sanitation (also annual monitoring)
	Annual monitoring	% households with year-round access to safe water
		% water/sanitation facilities maintained by community
Household food consumption	Impact	% households consuming minimum daily food requirements
		number of meals/snacks eaten per day
		number of different food/food groups eaten

continued

The Title II Generic Indicators - continued

Category	Level	Indicator
Agricultural productivity	Impact	annual yield of targeted crops
		yield gaps (actual vs. potential)
		yield variability under varying conditions
		value of agricultural production per vulnerable household
		months of household grain provisions
		% of crops lost to pests or environment
	Annual monitoring	annual yield of targeted crops
		number of hectares in which improved practices adopted
		number of storage facilities built and used
Natural resource management	Impact	imputed soil erosion
		imputed soil fertility
		yields or yield variability (also annual monitoring)
	Annual monitoring	number of hectares in which NRM practices used
		seedling/ sapling survival rate
FFW / CFW roads	Impact	agriculture input price margins between areas
		availability of key agriculture inputs
		staple food transport costs by seasons
		volume of agriculture produce transported by households to markets
		volume of vehicle traffic by vehicle type
		kilometers of farm to market roads rehabilitated
		selected annual measurements of the impact indicators