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Anthropometric Indicators Measurement Guide

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This series

This series of Title II Generic Indicator Guides has been developed by the Food and Nutrition Technical Assistance (FANTA) Project, and its predecessor projects (LINKAGES and IMPACT), as part of USAID's support to develop monitoring and evaluation systems for use in Title II programs. These guides are intended to provide the technical basis for the indicators and the recommended method for collecting, analyzing and reporting on the indicators. A list of Title II Generic Indicators that were developed in consultation with the Cooperating Sponsors in 1995/1996 is included in Appendix 8. The guides are available on the project website www.fantaproject.org.

Below is the list of available indicator guides:

- Agricultural Productivity Indicators Measurement Guide
- Food for Education Indicator Guide
- Food Security Indicators and Framework for Use in the Monitoring and Evaluation of Food Aid Programs
- Infant and Child Feeding Indicators Measurement Guide
- Measuring Household Food Consumption: A Technical Guide
- Sampling Guide
- Water and Sanitation Indicators Measurement Guide

I. Introduction

This guide provides information on the Anthropometric Impact Indicators and the Annual Monitoring Indicators for Maternal and Child Health/Child Survival (MCH/CS) and income-related Title II activities, a subset of the P.L. 480 Title II Generic Performance Indicators for Development Activities. The impact indicators are:

- **decreased percent of stunted children** (presented for ages 24-60 months and by gender), where stunting is defined as percent of children falling below -2 standard deviations for height-for-age;

- **decreased percent of underweight children** (in specified age groupings such as 12-24 months 36-59 months and by gender) where underweight is defined as percent of children falling below -2 standard deviations for weight-for-age.

These indicators are required for the reports of projects with specific nutrition components and are collected at baseline, mid-term and final-year evaluations. Stunting, reflected by deficits in height-for-age, would not be expected to change in a short time period. It is recommended, therefore, not to report stunting figures annually. Underweight (or weight for age), reported for specific age groupings, would change more quickly as it is influenced by short-term effects such as a recent outbreak of diarrheal diseases.

Some programs report stunting for children under 24 months of age rather than the recommended 24-60 months age grouping. Restricting the age grouping to children under 24 months has the disadvantage of not capturing the lagged effects of the program and reducing the numbers of potential participants in a survey. The advantage of using children under 24 months is that the data are more useful to determine the factors related to stunting for program design or redesign.

The monitoring indicators are:

- **increased percent of eligible children in growth monitoring/ promotion** (usually presented for children under 24 months or over 36 months of age, depending on the target group of the program);

- **increased percent of children in growth promotion program gaining weight in past 3 months** (by gender and age group, will depend upon the target group of the program).

The choice of indicators for annual monitoring and reporting should be based upon a review of available sources of data and the information needs of the Cooperating Sponsor and USAID. Reporting the annual monitoring indicators is recommended rather than required as in the case for reporting on impact. The primary purpose of collecting and reporting the monitoring indicators is to improve program management but these indicators can also provide valuable insights into the interpretation of the anthropometric indicators of program impact. In addition, reporting the annual indicators may provide Cooperating Sponsors a further opportunity to demonstrate progress towards the achievement of results.

While the focus of this guide is on the consistent collection and reporting of **nutritional anthropometry indicators** and **annual monitoring indicators**, suggestions are provided for additional information related to monitoring and evaluation. This information will help Cooperating Sponsors to track and improve child nutrition activities and performance. The focus is on anthropometric assessment of infants and young children. The guide is a programming tool and is not meant to substitute for adequate technical and academic training needed to conduct problem analysis, design programs and for implementation. Cooperating Sponsors are encouraged to seek technical expertise in nutritional assessment and related topics needed to ensure appropriate use of anthropometric indicators.

An inter-agency global initiative to improve the assessment, monitoring, reporting and evaluation of **humanitarian assistance** interventions has begun and is called **SMART** (Standardized Monitoring and Assessment of Relief and Transitions). The initiative is promoting an approach to routinely collect, analyze and disseminate nutrition and mortality data. Mortality and nutrition indicators are used to assess the severity of a crisis, identify needs, and prioritize resources. They are also used to monitor the extent to which the relief system is meeting the needs of affected populations and to gauge the overall impact and performance of humanitarian assistance in a given situation. The SMART initiative emphasizes the importance of interpreting data in context to provide a comprehensive picture of a given situation to facilitate effective decision-making. In addition to the basic nutrition and mortality indicators commonly used in the acute phase of an emergency, other important indicators will be reviewed and added as part of the collaborative effort.

The main indicators are Crude Mortality Rate (CMR) and the standard nutritional status indices of **wasting** (thinness or marasmus) and edema (kwashiokor) in children. Wasting is measured using **weight-for-height**. Wasting is defined as the percent of children (6-59 months) falling below -2 standard deviations for weight-for-height plus all children with edema.

The assessment of children over 5 years of age, adolescents, adults and the elderly is not the primary focus of the guide. Appendices 4 and 5, however, provide information on the nutritional assessments of adults and adolescents.

2. Anthropometric Evaluation and Annual Monitoring Indicators

2.1. Anthropometric Indicators

Changes in body dimensions reflect the overall health and welfare of individuals and populations. Anthropometry is used to assess and predict performance, health and survival of individuals and reflect the economic and social well being of populations. Anthropometry is a widely used, inexpensive and non-invasive measure of the general nutritional status of an individual or a population group. Recent studies have demonstrated the applications of anthropometry to include the prediction of who will benefit from interventions, identifying social and economic inequity and evaluating responses to interventions. For more information on the application of anthropometric data, refer to Appendix 2.

Anthropometry can be used for various purposes, depending on the anthropometric indicators selected. For example, weight-for-height (wasting) is useful for screening children at risk and for measuring short-term changes in nutritional status. However, weight-for-height is usually not appropriate for evaluating changes in a population over longer time periods. A clear understanding of the different uses and interpretations of each anthropometric indicator will help to determine the most appropriate indicator(s) for program evaluation. For more detailed explanations of age and sex specific appropriate anthropometric uses, refer to Appendices 4 and 5. Key terms are defined in the glossary. The anthropometric measurement of infants below six months of age for monitoring and evaluation purposes is not recommended.

2.1.1. The Building Blocks of Anthropometry: Indices

The four building blocks or measures used to undertake anthropometric assessment are:

1	2	3	4
AGE	SEX	LENGTH (or height)	WEIGHT

Each of these variables provides one piece of information about a person. When they are used together they can provide important information about a person's nutritional status. The actual measurement of age, weight and height of children requires specific equipment and techniques which are described later. When two of these variables are used together they are called an *index*. Three indices are commonly used in assessing the nutritional status of children:

- Weight-for-age;
- Length-for-age or Height-for-age;
- Weight-for-length or Weight-for-height.

There are many other anthropometric measures including mid - upper arm circumference (MUAC), sitting height to standing height ratio (Cormic Index), and many skinfold measures. This guide will concentrate on the measurements and interpretation of weight and height in children.

2.1.2. What the Indices Reflect About the Nutritional Status of Infants and Children

The advantages and disadvantages of the three indices and the information they can provide is summarized below:

Weight-for-age: Low weight-for-age index identifies the condition of being **underweight**, for a specific age. The advantage of this index is that it reflects both past (chronic) and/or present (acute) undernutrition (although it is unable to distinguish between the two).

Height-for-age: Low height-for-age index identifies past undernutrition or chronic malnutrition. It cannot measure short term changes in malnutrition. For children below 2 years of age, the term is length-for-age; above 2 years of age, the index is referred to as height-for-age. Deficits in length-for-age or height-for-age is referred to as **stunting**.

Weight-for-height: Low weight-for-height helps to identify children suffering from current or acute undernutrition or **wasting** and is useful when exact ages are difficult to determine. Weight-for-length (in children under 2 years of age) or weight-for-height (in children over 2 years of age) is appropriate for examining short-term effects such as seasonal changes in food supply or short-term nutritional stress brought about by illness.

The three indices are used to identify three nutritional conditions: underweight, stunting and wasting, respectively.

Underweight: Underweight, based on weight-for-age, is a composite measure of stunting and wasting and is recommended as the indicator to assess changes in the magnitude of malnutrition over time.

Stunting: Low length-for-age, stemming from a slowing in the growth of the fetus and the child and resulting in a failure to achieve expected length as compared to a healthy, well nourished child of the same age, is a sign of stunting. Stunting is an indicator of **past growth failure**. It is associated with a number of long-term factors including chronic insufficient protein and energy intake, frequent infection, sustained inappropriate feeding practices and poverty. In children over 2 years of age, the effects of these long-term factors may not be reversible. For evaluation purposes, it is preferable to use children under 2 years of age because the prevalence of stunting in children of this age is likely to be more responsive to the impact of interventions than in older children. Data on prevalence of stunting in a community may be used in problem analysis in designing interventions. Information on stunting for individual children is useful clinically as an aid to diagnosis. Stunting, based on height-for-age, can be used for evaluation purposes but is not recommended for monitoring as it does not change in the short term such as 6 - 12 months.

Wasting: Wasting is the result of a weight falling significantly below the weight expected of a child of the same length or height. Wasting indicates **current or acute malnutrition** resulting from failure to gain weight or actual weight loss. Causes include inadequate food intake, incorrect feeding practices, disease, and infection or, more frequently, a combination of these factors. Wasting in individual children and population groups can change rapidly and shows marked seasonal patterns associated with changes in food availability or disease prevalence to which it is very sensitive. 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 in emergency settings and is sometimes used for annual reporting. Weight-for-height is not advised for evaluation of change in non-emergency situations since it is highly susceptible to seasonality.

In **humanitarian assistance** activities, **wasting** (a SMART indicator) or thinness in children in the 6-59 month age range, combined with nutritional **edema**, is an indicator of acute malnutrition and should be used to reflect the overall **severity** of a crisis. Wasting is determined using **weight-for-height** (WFH) and is calculated as the weight of each child in relation to the weight of a well nourished reference child of the same sex and stature using the U.S reference standards. Weight-for-height is expressed using Z scores (standard deviations from the reference median). Percentage of the reference median should also be reported as it is used as the entry criteria for feeding programs. When counting children as wasted, it is important to include all under fives who have pitting edema in their limbs. Reporting using Z score is preferred for assessments and surveys and weight-for-height percent of the median is preferred for admission into treatment.

- **Edema** is the presence of excessive amounts of fluid in the intracellular tissue. Edema can be diagnosed by applying moderate thumb pressure to the back of the foot or ankle. The impression of the thumb will remain for some time when edema is present. Edema is diagnosed only if both feet show the impression for some time. As a clinical sign of severe malnutrition, the presence of edema should be recognized when using short term indicators such as wasting. The presence of edema in individuals should be recorded when using weight-for-height for surveillance or screening purposes. When a child has edema, it is automatically included with children counted as severely malnourished, independently of its wasting, stunting, or underweight status. This is due to the strong association between edema and mortality. Edema is a rare event and its diagnosis is used only for screening and surveillance and not for evaluation purposes.

- **Mid - Upper Arm Circumference (MUAC)** is relatively easy to measure and a good predictor of immediate risk of death. It is used for rapid screening of acute malnutrition from the 6-59 month age range (MUAC overestimates rates of malnutrition in the 6-12 month age group). MUAC can be used for screening in emergency situations but is not typically used for evaluation purposes (MSF, 1995). MUAC is recommended for assessing acute adult undernutrition and for estimating prevalence of undernutrition at the population level.

2.2. Annual Monitoring Indicators

Well chosen and reported monitoring indicators will enhance program management and can provide valuable insights into trends of anthropometric indicators used for determining impact. Part 8 of this Guide describes how annual monitoring indicators that are based upon data from growth monitoring and promotion programs (GMP) may be collected and reported in a standard format. This is intended to make the indicators more useful for management of programs at all levels within countries, and also for reporting to USAID.

The two recommended **annual monitoring indicators** serve several purposes.

1. Percent of eligible children in Growth Monitoring and Promotion programs

a. supports program management – providing information on coverage, targeting, and may provide a useful basis for supervision of field staff;

b. provides information on context, or some explanation, in the reporting of anthropometric impact indicators; and

c. provides an indication of patterns of, or trends in, service delivery and use and thus has potential to demonstrate successes of efforts to achieve specified project results.

2. Percent of children in Growth Monitoring and Promotion (GMP) programs gaining weight in past 3 months (by gender)

a. As a **management tool**, this information is a trigger to increase growth promotion and health education counseling. The information can be a positive communication between the health worker and caregiver concerning the health of the child. This information is most effective when provided with other information such as food availability and presence or history of infection.

b. As a **surveillance tool**, the indicator may be useful as a lagged indicator of a community facing severe food or health-related stress. The usefulness of this indicator for surveillance is reduced when small numbers are being monitored.

A major advantage for an organization in reporting on the two monitoring indicators is that it provides national level staff with a framework to think about, interpret, and act upon data that are currently being reported to them. A barrier to "institutionalizing" the reporting of monitoring data is that often no action is taken on information reported and sometimes no meaningful feedback is provided to the staff who collect and report them. Reporting on monitoring indicators at a national level will provide some evidence that GMP data have been collected and used as intended.

Growth monitoring and promotion programs are key components of many food assisted health and nutrition activities of Title II programs. The development of the guidelines presented here was based upon four assumptions:

1) growth monitoring without growth promotion will not benefit the health of participating children;

2) it is not useful to report village-level activities of GMPs to regional and national levels unless some action is taken, or some decision is based upon the information reported;

3) the reporting system will not be sustainable without some meaningful action or feedback; and

4) continuing effort will be required to improve the quality of data reported from GMP activities, but reporting GMP data can be useful when it is interpreted within an appropriate context.

3. Collecting Anthropometric Data Through Surveys

The type of anthropometric data collected will depend on the reason for the survey. When the survey results will be used for long-term planning, the information needed might be different than information for program management. The evaluation of Title II programs is a situation in which long-term changes in stunting or undernutrition need to be reflected. Monitoring of growth promotion programs will require different types of information.

The collection of anthropometric data may be the main purpose of a survey or it may be part of a larger more comprehensive survey such as the KPC (Knowledge, Practice, Coverage). Information on individuals and households should be collected to interpret anthropometric data. Deciding what information will be collected, how it will be collected and from whom it will be collected is all part of planning the survey. The steps that should be taken to conduct a survey are outlined below.

3.1. Steps for Conducting a Survey

The following checklist outlines the steps necessary for conducting a survey. All of these steps should be clearly thought out before the survey begins.

- **Define survey objectives.** The first step is to determine the specific purpose of the survey. Make a detailed list of what is expected to be achieved and what information is needed.

- **Budget for the survey.** Develop a detailed item-by-item budget for all the costs and expenses of the survey, including personnel, supplies, materials, transportation, accommodation and meals. Determine the costs associated with data entry, cleaning, analysis, reporting and testing of all steps to ensure smooth implementation.

- **Choose the survey design.** Depending on the goal of the survey, the survey planning team should review different design possibilities such as a case-control or reflexive design before choosing the final design. Having a clear idea of the survey goals will help to determine which people or which groups of people to include in the survey and the best method for collecting the information.

- **Plan for personnel, facilities, and equipment.** Conducting a survey within a limited time-frame (usually less than six months) requires early planning for materials and staff. During this stage the survey planning team decides how many field staff and how many office personnel they will need and how they will recruit them. Any advance work needed to find and hire staff is planned at this point. Other needs such as office space and equipment are also considered and planned. Specific equipment is needed to do anthropometric assessments as part of a survey and is discussed in Part 4.

- **Select the sample.** Once the survey goals and methods of collecting the information have been decided, the groups and numbers of people to be interviewed are selected. A sample is a small part of the group being studied that has been chosen to represent the whole group. There are special considerations when choosing a sample for anthropometric assessment. Sampling is discussed in Appendix 3 and the reader is referred to the FANTA Sampling Guide at www.fantaproject.org/publications.

- **Develop the questionnaire.** The list of essential information needed to meet the survey objectives forms the basis of the survey questionnaire. A standard, printed questionnaire ensures that all the respondents are asked the same questions and enables the survey responses to be tabulated easily and quickly. The questionnaire may need to be translated into local languages. Translated questionnaires should be translated back to the original language by another translator and compared to the original questionnaire. Enumerators need to be trained in the appropriate use of the translation. See Figure 5.6 for a sample questionnaire.

- **Pre-test the questionnaire.** Before the questionnaire is finalized, it should be tested for content and length; the questions should gather the needed information and should be easily understood by both interviewers and respondents. In the pre-test, a small number of interviews are conducted and the questionnaire is revised on the basis of these results and comments from the interviewers.

- **Train personnel.** Training of field staff is a vital step in the survey process; accurate, meaningful information can be collected only if interviewers thoroughly understand all their field instructions and procedures. When all the field materials have been prepared and finalized, and the field staff has been hired, all interviewers and supervisors should be brought to a central location to be taught survey procedures, how to collect the data and how to use the questionnaire. When anthropometric assessment will be part of the survey, correct methods for taking measurements should also be part of the training schedule (see Section 5.2). If the actual survey is delayed for more than three weeks following training, it will be necessary to retrain personnel.

- **Standardize the anthropometric technique.** The training of personnel on specific measurement and recording techniques should include not only theoretical explanations and demonstrations, but also provide an opportunity for participants to practice the measurement techniques, as well as reading and recording the results. Once all personnel have adequately practiced the measurement and recording techniques, and feel comfortable with their performance, standardization exercises should be carried out to ensure that all interviewers acquire the skills necessary to collect high quality data. Details of these exercises are presented in Appendix 6.

- **Interview.** The success of a survey depends on the quality of the field procedures, supervision and interviewing. Interviewers should follow sampling and interviewing instructions precisely and accurately. They need to keep in touch with their field supervisor and bring any problems or difficulties to their attention.

- **Supervise the data collection.** Once the interviewing begins, field supervisors should be present to assist interviewers with problems that may arise in finding the correct households, conducting the interviews or completing the work on time. Field supervisors, in addition to solving field problems, are responsible for distributing materials, reviewing and checking completed questionnaires and making progress reports to the central office. Detailed guidelines for supervisors are presented in Appendix 7.

- **Edit and code the interviews.** Completed interviews should be reviewed to make sure all the questions have been asked and the answers have been recorded clearly. Someone from the survey planning team should check all numerical codes on the questionnaire and assign codes to any responses written in respondents' own words. Some surveys directly enter data into the computer at the time of the measurement. This improves quality and speed but requires functioning equipment in often difficult conditions.

- **Tabulate the data.** Whether the survey results are to be compiled by hand or by computer, the responses for each questionnaire will have to be assigned numerical codes. This process is usually simplified by including numerical codes for each of the response categories on to the printed questionnaire form. When the interviews are completed, these codes are then transferred by hand to tabulation sheets or the codes can be entered into a computer. Both of these methods allow the survey results to be read and interpreted by means of statistical tables and percentages. As field computers and satellite communication become more common, it will be possible to enter data directly by the interviewer with immediate feedback for possible errors in measurement and recording.

- **Analyze and report the survey results.** On the basis of the tables prepared, the survey data are studied and interpreted, and conclusions are drawn about the nutritional and socio-economic conditions of the households in the project area. The report on the survey contains the most important findings and conclusions, statistical tables and a description of the procedures used in conducting the survey. The survey results should be presented in a clear and straightforward manner.

PART 4. Weighing and Measuring Equipment

Equipment is required to do anthropometric assessment. The most common types of equipment used are scales and measuring boards. Sources for obtaining equipment and tips on what to look for in equipment are listed below. Whatever equipment is chosen, staff need training to ensure its proper use and care. For Title II Cooperating Sponsors, electronic weighing scales and locally adapted height measuring boards are recommended. Check with the local UNICEF office for their specifications and availability. UNICEF equipment specifications can be found in the supply catalog at: www.supply.unicef.dk/catalogue/index.htm in the 03 Nutrition Section (use Internet Explorer).

4.1. Scales

Scales used in the field should be portable, durable and capable of reading up to 25 kg for children and have 100 gram increments. Spring scales are the most common scale available. There are several different attachments that can be used to help weigh children with spring scales. The size of the child will determine which attachment should be used. For weighing infants, a sling or basket is usually attached to the spring scale. For children, weighing trousers are used to suspend them. These are small pants with straps that the child steps into. The trousers are then hung from the scale by the straps. There are other alternatives than the trousers, but they can be difficult to use for infants and small children. For infants, a cloth folded to hang from the scale with the infant is preferred. For children who are old enough to grasp firmly onto something, a handle is sometimes attached to the scale and the child hangs from it by their hands until their weight is read. Whatever is used to suspend the child, the scale should be zeroed to ensure that the weight of the trousers, sling or basket is not added to the child's weight.

Oxfam Anthropometric Kit 1 (UNICEF Item No. 0000824) (Survey, screening, monitoring): The Anthropometric Kit contains equipment for measuring the weight and height of children to assess their nutritional status, along with other materials for nutritional surveys. The kit weighs 26 kgs and contains measuring and survey materials for two survey teams, or measuring equipment for 2 feeding centers, and contains:

Oxfam Anthropometric Kit 1

Code	Qty	Description
NK3	2	Backpacks - nylon
NK6	2	Boards - height/length and head block
NK7	4	Books - exercise
NK20	2	Calculators - solar and battery
NK26	4	Clipboards - A4, folding, spring clip
NK29	1	Roll cord 10M x 6mm, polypropylene, endless fibres

Code	Qty	Description
NK30	2	Counters - manual/hand held, metal
NK31	4	Erasers
NK32	2	Forms - evaluation
NK33A	1	Notes on the revised Oxfam Feeding Kits - English
NK33B	1	Notes on the revised Oxfam Feeding Kits - French
NK34	40	Forms - survey
NK39	2	Pads, paper, four colors of paper,100 pages per pad, 90 x 90mm
NK40	1	Pad, paper, graph, A4 in mm
NK41	10	Pens - BIC ballpoint, black, medium
NK42	4	Pens - large, indelible, black marker
NK44	12	Pencils - HB
NK45	4	Pencil sharpeners - metal, single hole
NK51	4	Rulers, 30cm, transparent, flat, plastic, shatterproof
NK53	2	Scales, 25kg hanging scale, with bar, 3 pants and sling, 100gm graduation
NK55	1	Scissors - 17cm, blended
NK63	4	Tables - random number A4, plasticized
NK64	4	Tables - %Weight-for-height NCHS/CDC/WHO Sex combined, elasticized
NK65	4	Tables, Weight-for-height Z-score NCHS/CDC/WHO Sex combined, plasticized
NK66	2	Tape measures - fiberglass
NK67	50	Tapes, MUAC: red (<11cm), orange (11-12.5cm), white 12.5-13.5cm), green (>13.5cm)
NK68	2	Rolls, tape - metric adhesive
NK77	10	Wallets - A4 transparent plastic, open on 2-sides

Publications - Books

NK80	2	Food Scarcity and Famine - Oxfam Practical Guide No. 7
NK83	1	MSF Nutrition Guidelines - English
NK84	1	MSF Nutrition Guidelines - French
NK85A	1	Refugee Health Care - Oxfam Practical Guide No. 9 - English
NK85B	1	Refugee Health Care - Oxfam Practical Guide No. 9 - French
NK86	1	Selective Feeding Program - Oxfam Practical Guide 1 - English
NK87	1	Selective Feeding Program - Oxfam Practical Guide 1 - French

Unless weighing and measuring equipment is available locally, the Anthropometric Kit should be bought together with the Therapeutic Kit (Kit 4) or supplementary Kit (Kit 2 or Kit 3) for the initial establishment of feeding programs.

Electronic Scales

UNICEF and others have found electronic scales to be durable and flexible especially given the option of weighing the mother with the child. The mother can be weighed with the child. The mother is then weighed without the child. The difference between the two measures is the child's weight. This technique is useful in situations where the child struggles and use of a sling or weighing pants causes stress for the child. An additional advantage is that the weight of the mother is also available.

Each member of the field staff should have their own scale if possible, otherwise it might take longer to do measurements and complete the survey. Several scales that are available for purchase are listed below:

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 long-life lithium battery good for one million weighing cycles. Instructions are available in English, French and Spanish.

The major advantage of this scale is the micro-computer chip so that it can adjust to zero and weigh people quickly and accurately. The child may be weighed directly. 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 there have been some difficulties with heat adversely affecting the scale. The price of this scale is US$90. 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).

UNICEF Hanging Scale (Item No. 0145555 Scale, infant, spring, 25kg x 100g with No. 0189000 Weighing trousers/pack of 5): This is a Salter-type spring scale with a capacity of 25 kg and 100 gram increments. Using this scale requires that the child be dressed in a set of plastic or nylon trousers before being weighed. The interviewers will need several pairs of these special trousers if they are going to use hanging scales. A hook for hanging the scale from a door or a ceiling beam may also be necessary. The scale should be checked periodically with standard 5 or 10 kg weights. This beam-and-spring or dial type scale has two suspension hooks, an adjustment screw on top, and should be suspended from a solid support. The 1 kilogram scale is easy to transport and practical to use. Provided WITHOUT weighing trousers. Weighing trousers must be ordered separately, in the proportion of 1 scale per 1 pack of 5 trousers, item no. S0189000, in pack of 5. The price of this scale is about US$30. 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).

TALC Weighing Scale: The TALC scale can be used like any other hanging scale, with the advantage that a growth chart can be put in it, and the child's weight is marked directly from the pointer on the spring. The TALC scale can be made locally from a TALC starter kit. This includes three springs, instructions and three specimen growth charts. The scale can also be made from local materials with the purchase of the TALC scale spring and instructions. A TALC sample pack includes spring, hook, nylon cord, wood pieces, screws and instructions (approximately US$25). These can be ordered from: Teaching Aids at Low Cost, P.O. Box 49, St. Albans, Herts AL1 4AX, England; Telephone: (44) 0 1727 853869; Fax: (44) 0 1727 846852; Website: www.talcuk.org. Payments from overseas must be made by: (1) International Money Order, National Giro or U.K. Postal Order; (2) Sterling check drawn on a U.K. bank; (3) Eurocheque made out in Sterling; (4) US dollar check drawn on US bank using the correct rate of exchange; or (5) UNESCO Coupons.

Suspended Infant Weighing Pack (Model No. PE-HS-25): This scale was developed in conjunction with the US Centers for Disease Control (CDC). It is a dial scale made of durable plastic with an easy to read face. It is capable of weighing up to 25 kg in 100 gram increments. The one-kilogram pack includes a sling, weighing trousers, a detachable handle for weighing larger children and a vinyl shoulder bag. The price is US$150. Additional slings, trousers and handles are available for US$12. For information on this pack contact: Perspective Enterprises; 7829 Sprinkle Road; Portage, MI 49002, USA; Telephone: (269) 327 0869 or (800) 323 7452; Fax: (269) 327 0837; Email: pepdc@perspectiveent.com; Website: www.perspectiveent.com.

Chasmors Ltd. Model MP25: This is a lightweight scale with a stainless steel case and an unbreakable plastic cover. It is easy to read and can weigh up to 25 kg in 100 gram gradations. The scale comes with two weighing trousers and one sling (for newborns). The price is US$75. Chasmors also carries a variety of arm circumference measuring tapes ranging from US$10 to US$30. For more information on their products contact: CMS Weighing Equipment, Ltd.; 18 Camden High Street; London NW1 OJH, U.K.; Telephone: 01 387 2060; (44) 020 7383 7030.

Salter Model 235-6S: This is a lightweight scale in a durable non-rust metal case with an unbreakable plastic face. Its capacity is 25 kgs with 100g increments. The price is US$77. For more information contact: Salter Industrial Measurement, Ltd.; George Street, West Bromwich; West Midlands, B70 6AD, U.K.; Telephone: (44) 121 553 1855. In the US - Salter Weighing Products; 3620 Central Avenue, N.E., Minneapolis, MN 55418;

Telephone: 800 637 0529; Fax: (612) 781 4320; Email: sales@salterweighing.com; Website: www.salterweighing.com.

Medecins sans Frontieres Nutrition Survey Kit (MSF code: KMEDKNUT4M): This kit includes standard equipment for surveys, including a Salter hanging scale. It comes in one box and weighs 23 kgs. The price is approximately US$600. The kit can be bought at TRANSFER (formerly associated with MSF-Belgium). TRANSFER can be contacted by email at office-transfer@msf.be. Website: www.transfer.be. Telephone: 32 (0) 52 261 000. Fax: 32 (0) 52 261 001. Use Acrobat Reader to read the supply catalog.

4.2. Length/Height Boards

Length/height boards should be designed to measure children under 2 years of age lying down (recumbent), and older children standing up. The board should measure up to 120 cm (1.2 meters) for children and be readable to 0.1 of a centimeter. A measuring board should be lightweight, durable and have few moving parts. The metal part on the boards absorbs heat easily so care must be taken in field conditions. Another concern with length/height boards is that they resemble coffins and this can be disconcerting to the caregiver. Check with the survey personnel and adjust the design. Provide adequate training both in using the equipment and in providing appropriate information for the caregiver. Ideally, each field staff should have their own board. This makes the survey process more efficient than when boards have to be shared. Several types of length and height boards are available and are listed below. The Dutch infant-child-adult measuring board is recommended but local adaptations are possible to reduce the cost.

UNICEF Model (Item No. 0114500 Infant length/height measuring board): An infant/child height measuring board measuring both recumbent length and standing height. This board is made of smooth-finish wood with all parts glued and screwed; height is 130 cm (collapses to 75 cm); width 30 cm; with an estimated weight of 10 kg. The board comes with a shoulder strap. Illustrated instructions for assembly and use are included, as well as guidelines and plans for local construction. The price of the board is about US$350. 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).

Infant/Child Height/Length Measuring Board: This board has 130 cm capacity (collapses to 75cm) and has 0.1 cm increments. The board weighs 6 kg, is portable, water-resistant and has an adjustable, removable nylon shoulder strap. It is easy to assemble and dismantle, with the sliding head-footpiece stored in the base of the board for transport or storage. This board has a lifetime warranty and costs $285. For more information contact: Shorr Productions; 17802 Shotley Bridge Place; Olney, Maryland 20832, USA; Telephone: (301) 774 9006; Fax: (301) 774 0436; Email: ijshorr@shorrproductions.com.

Infant Recumbent Length Board (Model No. PE-RILB-122-PC): This board is lightweight, durable and capable of measuring recumbent length up to 100 cm. The price of this board is US$215. For more information contact: Perspective Enterprises; 7829 Sprinkle

Road; Portage, MI 49002, USA; Telephone: (269) 327 0869 or (800) 323 7452; Fax: (269) 327 0837; Email: pepdc@perspectiveent.com; Website: www.perspectiveent.com.

Recumbent Length Measuring Board: This board has 106 cm capacity in 0.1 cm increments and costs $185. For more information contact: Shorr Productions; 17802 Shotley Bridge Place; Olney, Maryland 20832, USA; Telephone: (301) 774 9006; Fax: (301) 774 0436; Email: ijshorr@shorrproductions.com.

Infant Measuring Board (Model No. PE-RILB-LTWT): This measuring board is designed to be especially lightweight and extremely portable. It can measure up to 100 cm, is collapsible and comes with a vinyl plastic tote bag. The price of this board is US$250. For more information contact: Perspective Enterprises; 7829 Sprinkle Road; Portage, MI 49002, USA; Telephone: (269) 327 0869 or (800) 323 7452; Fax: (269) 327 0837; Email: pepdc@perspectiveent.com; Website: www.perspectiveent.com.

Portable Adult/Infant Measuring Board (Model No. PE-AIM-101): This is an adjustable measuring board which has been extensively used by World Health Organization (WHO) and CDC, with a vertical aluminum post. It can measure the height of adults and then by taking off its vertical extension it can be adapted to measure infants. When collapsed, it is approximately the length of two briefcases laid end to end. It also has an optional vinyl carrying case. The price of this board is US$385. For more information contact: Perspective Enterprises; 7829 Sprinkle Road; Portage, MI 49002, USA; Telephone: (269) 327 0869 or (800) 323 7452; Fax: (269) 327 0837; Email: pepdc@perspectiveent.com; Website: www.perspectiveent.com.

Infant/Child/AdultHeight/Length Measuring Board: This measuring board has a 200 cm capacity (collapses to 85 cm) and has 0.1 cm increments. The board weighs 6 kg, is portable, water-resistant and has an adjustable, removable nylon shoulder strap. It is easy to assemble and dismantle and costs US$355. For more information contact: Shorr Productions; 17802 Shotley Bridge Place; Olney, Maryland 20832, USA; Telephone: (301) 774 9006; Fax: (301) 774 0436; Email: ijshorr@shorrproductions.com.

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 at a price of 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 (Harpenden Pocket Stadiometer): An inexpensive height measuring device useful for children over 24 months and adults (range 0-200cm). The price is approximately US$100. Contact: CMS Weighing Equipment, Ltd.; 18 Camden High Street; London NW1 OJH, U.K.; Telephone: 01 387 2060; (44) 020 7383 7030.

Medecins sans Frontieres Height Measuring Apparatus (MSF code: EMEQMEAA5P): Supplied by MSF Holland, the 7.3 kg pack contains an aluminum board for child or adults (max height is 200 cm). Children under 2 years of age are measured lying down. The price is approximately US$270. The kit can be bought at TRANSFER (formerly associated with MSF-Belgium). TRANSFER can be contacted by email at office-transfer@msf.be. Website: www.transfer.be. Telephone: 32 (0) 52 261 000. Fax: 32 (0) 52 261 001. Use Acrobat Reader to read the supply catalog.

Local Construction: Various plans exist for the local construction of foldable height/length boards and they can be made for around US$20. It is important that the materials are durable, lightweight and the wood should be well seasoned to guard against warping. Sealing the wood with water repellant and ensuring the measuring tape is protected from wear will improve the durability of the board. The tape measure should be durable with 0.1 cm increments and the numbers of the tape measure must be next to the markings on the board when the measure is glued to the side of the board. The boards should be long enough to measure children up to 5 years and a "correction" factor is needed to convert recumbent length to standing height for children over 24 months in order to use the WHO/NCHS growth reference standards. Designs can be found in Annex 4 of the FAO field manual. Blueprints for the construction of portable measuring boards are available from the Nutrition Division of Cornell University as well as from the Center for Health Promotion and Education of the Centers for Disease Control and Prevention, 1600 Clifton Road, N.E., Atlanta, GA 30333, USA; Website: www.cdc.gov.

4.3. Mid-Upper Arm Circumference Measure

MUAC Tape (UNICEF Item No. 145600 Arm circumference insertion tape/pack of 50): This arm circumference insertion tape measures mid-upper arm circumference of children, up to 25 cm. Color-coded in red/yellow/green, non-tear, stretch-resistant plasticized paper. Supplied in pack of tapes together with written and pictorial instructions for use. Refer to UNICEF's Supply Division in Copenhagen through any UNICEF field office.

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).

PART 5. Taking Measurements

Accurate anthropometric measurement is a skill requiring specific training. A number of tools are available and additional references and sources are provided in Appendix 6. Training requires step-by-step procedures to follow when taking measurements. Standardizing methods helps ensure that the measurements will be correct and makes comparisons possible. Comparisons may be done between data collected from different areas of a country, between different surveys or between measurements and the reference standards. None of these comparisons will be possible without a standard method for taking measurements. This section will cover the necessary field equipment and methods for taking measurements.

5.1. Interviewer Field Materials

The checklist below includes the equipment and materials interviewers should have with them in the field. All of these items may not be necessary for every survey.

- Equipment bag
- List of assigned households and their addresses (or location)
- Map of the area
- Log book
- Pre-numbered questionnaires for assigned households
- Spare questionnaires
- Waterproof envelopes for blank and completed questionnaires
- Weighing scale
- Scale hooks
- Weighing pants or hanging swing
- Storage bag for pants
- Piece of rope for scales
- Storage box for scales
- Height/length measuring board
- Sliding head/foot pieces
- Clipboard
- Stapler and box of staples
- Pencils and pencil sharpener
- Eraser
- Pens
- Spare paper

5.2. Procedures Before Measuring

There are a few preparatory procedures and decisions that should be addressed prior to obtaining measurements. Guidelines to make the field experience easier are:

Initial preparation. Ensure that the mother or caretaker understands what is happening to the child. The measurement of weight and length can be traumatic. Participants need to be comfortable with the process. The equipment should be cool, clean and safely secured. Work out of direct sunlight since it can interfere with reading scales and other equipment and it is more comfortable for the measurer and child.

Ethically handling anthropometric data in surveys. Taking measurements on individuals can be intrusive and time consuming. It is the responsibility of the survey team to minimize the discomfort and inconvenience of the survey and anthropometric measurement. There are principles that need to be applied in conducting surveys and it is the responsibility of the organizers to ensure that the survey is conducted in accordance with national or international standards for the ethical treatment of participants in research and surveys. These procedures are especially relevant when dealing with biological tests such as the drawing of blood and clinical assessment.

Since simple anthropometric measurements have minimal intrusion on the time and privacy of individual respondents and the benefits of the survey are shared by the community with better program design and implementation, the requirements are manageable. It is necessary to explain in a non-threatening and culturally relevant manner the purpose and contents of the survey while providing the listener an opportunity to ask questions and decline participation if necessary.

Informed consent from caregivers for the survey is necessary. Secure consent prior to administering a survey questionnaire or undertaking any measurement. Consent is sought from each participant (or caregiver) from the sample frame. In general, literate participants are asked to read and sign a consent form, while the form is read out to illiterate participants, who then give verbal consent. Consent for any research study must be secured at a national and community level through the appropriate ethical board or other authority. The requirement for approval for population surveys and anthropometric measurements as part of program activities is often not clear but it is necessary to check. In the case of an externally funded survey, the funding country may also expect to review and clear the protocol for the proposed work.

When anthropometric measurements will be linked to any biological test results, it is essential that approval be sought and the respondent or caregiver be explained as to how the information will be used and by whom. Confidentiality of the information collected must be assured and maintained.

On-the-spot diagnosis presents special challenges. The survey organizers must decide about responsibilities for treatment or referral for those reporting or found to be suffering from illness or malnutrition. Research studies obtaining health and nutrition information usually require participants to be advised of the test results and treatment provided where necessary. This has not, however, been the case in population-based surveys. In anthropometric surveys, it is often difficult for enumerators to inform caregivers of the nutritional status of the child. This is due to the calculations needed to convert measurements into indices at the time of measurement due to computation requirements at the time of measurement.

Sharing results and referral in situations where a diagnosis is made or measurements can be interpreted with on-site generation or where there is overt signs of severe malnutrition and/or illness, enumerators should refer the person to the nearest health facility or professional for treatment.

Two trained people required. When possible, two trained people should measure a child's height and length. The measurer holds the child and takes the measurements. The assistant helps hold the child and records the measurements on the questionnaire. If only one trained person is available to take the measurements, then the child's mother can help. The measurer would also record the measurements on the questionnaire.

Measuring board and scale placement. There will usually be several choices on where to place the measuring board or scale, but the choice should be made carefully. Be sure that you have a sturdy, flat surface for measuring boards, a strong place to hang scales from and adequate light so the measurements can be read with precision.

When to weigh and measure. Weighing and measuring should not be the first thing you do when you start an interview. It is better to begin with questions that need to be answered. This helps make the mother and child feel more comfortable before the measurements begin.

Weigh and measure one child at a time. You should complete the questions and measurements for one child at a time. This avoids potential problems with mix-ups that might occur if you have several children to measure.

Control the child. When you are taking weight and length/height measurements, the child needs to be as calm as possible. A child who is excited or scared can make it difficult to get an accurate measurement.

Recording measurements. All measurements should be recorded in pencil. If a mistake is made when recording a measurement, it can be corrected.

5.3. How to Measure Age, Height, Length, Weight and MUAC

The following suggestions are adapted from *How to Weigh and Measure Children: Assessing the Nutritional Status of Young Children in Household Surveys*, United Nations Department of Technical Cooperation for Development and Statistical Office, 1986.

5.3.1. Age

The child's accurate age is required for sampling, deciding on whether the child is measured standing or reclining for height or length, and for converting height and weight into the standard indices. At the time of measurement, an age estimate is needed for decisions on sampling and for the position on the measuring board. It is recommended the enumerators use simple methods to approximate the age and that the data analyst calculates the age using a computer program which will require the date of birth and date of measurement.

To complete the determination, the enumerator needs to examine documentary evidence of the birth date (such as birth, baptismal certificate, clinic care or horoscope). Cross-checking is necessary even if the mother knows the birth date or age of the child as errors in recall are common. Where there is a general registration of births and where ages are generally known, the recording of age is a straightforward procedure, with age measured to the nearest month or year as the case may be. For example, an infant whose date of birth is 13 July, 1996 could be recorded as being 6 months if seen between 13 December, 1996 and 12 January, 1997 (both dates inclusive). Similarly, a child born on 13 July, 1995 could be recorded as 6 years old if seen between 13 July 2001 and 12 July, 2002 (both dates inclusive). If dates cannot be recalled, use of a local calendar will assist mothers in recalling the date of birth. Construction of the local calendar should be done prior to the survey and tested using the enumerators.

5.3.2. Height for children 24 months and older (*Figure 5.1*)

1. Measurer or assistant: Place the measuring board on a hard flat surface against a wall, table, tree, staircase, etc. Make sure the board is not moving.

2. Measurer or assistant: Ask the mother to remove the child's shoes and unbraid any hair that would interfere with the height measurement. Ask her to walk the child to the board and to kneel in front of the child. If a Microtoise measure is used, stand the child vertically in the middle of the platform.

3. Assistant: Place the questionnaire and pencil on the ground (Arrow 1). Kneel with both knees on the right side of the child (Arrow 2).

4. Measurer: Kneel on your right knee on the child's left side (Arrow 3). This will give you maximum mobility.

5. Assistant: Place the child's feet flat and together in the center of and against the back and base of the board/wall. Place your right hand just above the child's ankles on the shins (Arrow 4), your left hand on the child's knees (Arrow 5) and push against the board/wall. Make sure the child's legs are straight and the heels and calves are against the board/wall (Arrows 6 and 7). Tell the measurer when you have completed positioning the feet and legs.

6. Measurer: Tell the child to look straight ahead at the mother who should stand in front of the child. Make sure the child's line of sight is level with the ground (Arrow 8). Place your open left hand under the child's chin. Gradually close your hand (Arrow 9). Do not cover the child's mouth or ears. Make sure the shoulders are level (Arrow 10), the hands are at the child's side (Arrow 11), and the head, shoulder blades and buttocks are against the board/wall (Arrows 12, 13, and 14). With your right hand, lower the headpiece on top of the child's head. Make sure you push through the child's hair (Arrow 15).

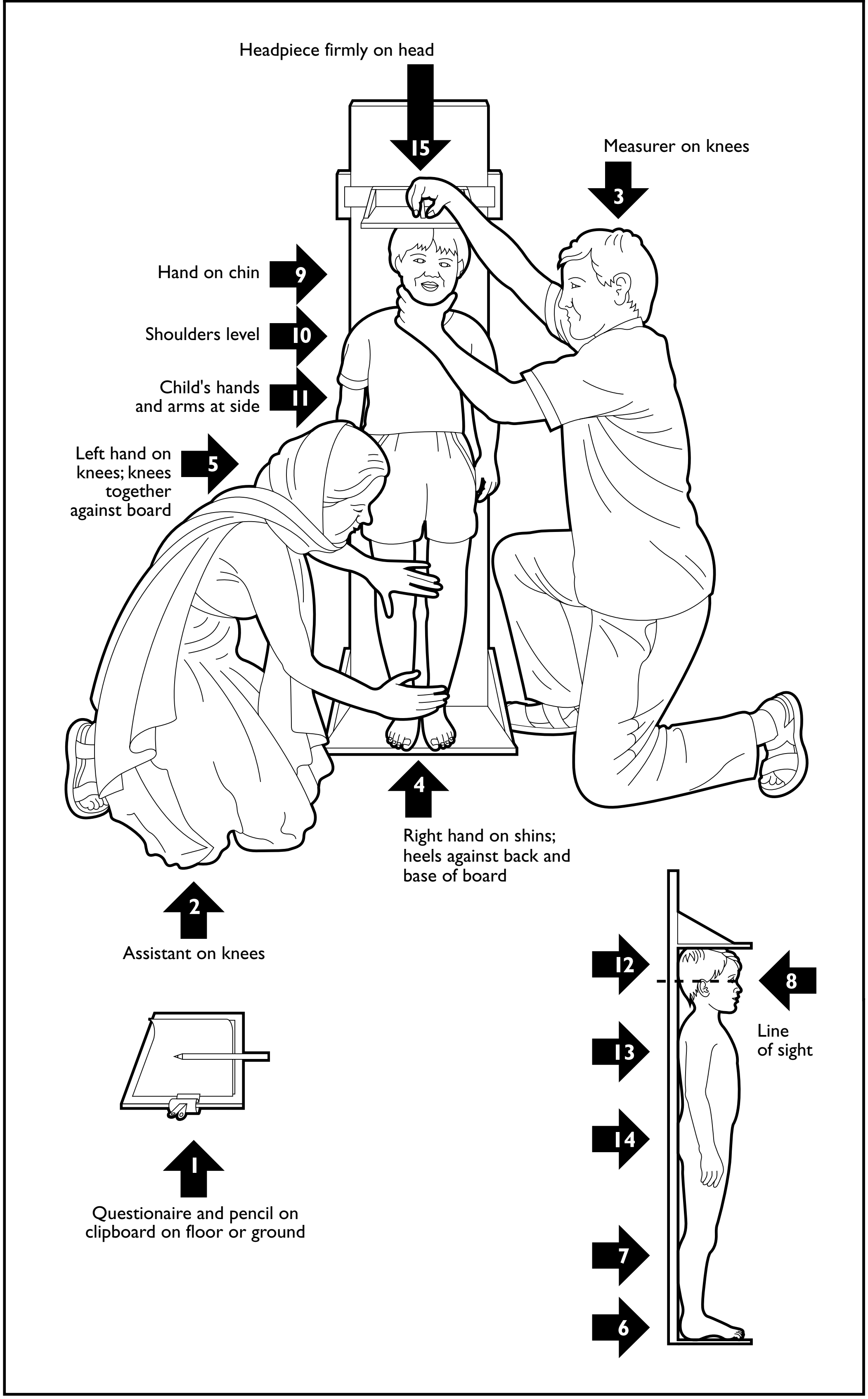
7. Measurer and assistant: Check the child's position (Arrows 1-15). Repeat any steps as necessary.

8. Measurer: When the child's position is correct, read and call out the measurement to the nearest 0.1 cm. Remove the headpiece from the child's head and your left hand from the child's chin.

9. Assistant: Immediately record the measurement and show it to the measurer.

10. Measurer: Check the recorded measurement on the questionnaire for accuracy and legibility. Instruct the assistant to erase and correct any errors.

Figure 5.1. Child Height Measurement - Height for Children 24 Months and Older



Source: How to Weigh and Measure Children: Assessing the Nutritional Status of Young Children, United Nations, 1986.

5.3.3. Length for infants and children 0-23 months (*Figure 5.2*)

1. Measurer or assistant: Place the measuring board on a hard flat surface, i.e., ground, floor, or steady table.

2. Assistant: Place the questionnaire and pencil on the ground, floor, or table (Arrow 1). Kneel with both knees behind the base of the board if it is on the ground or floor (Arrow 2).

3. Measurer: Kneel on the right side of the child so that you can hold the foot piece with your right hand (Arrow 3).

4. Measurer and assistant: With the mother's help, lay the child on the board by supporting the back of the child's head with one hand and the trunk of the body with the other hand. Gradually lower the child onto the board.

5. Measurer or assistant: Ask the mother to kneel close on the opposite side of the board facing the measurer as this will help to keep the child calm.

6. Assistant: Cup your hands over the child's ears (Arrow 4). With your arms comfortably straight (Arrow 5), place the child's head against the base of the board so that the child is looking straight up. The child's line of sight should be perpendicular to the ground (Arrow 6). Your head should be straight over the child's head. Look directly into the child's eyes.

7. Measurer: Make sure the child is lying flat and in the center of the board (Arrows 7). Place your left hand on the child's shins (above the ankles) or on the knees (Arrow 8). Press them firmly against the board. With your right hand, place the foot piece firmly against the child's heels (Arrow 9).

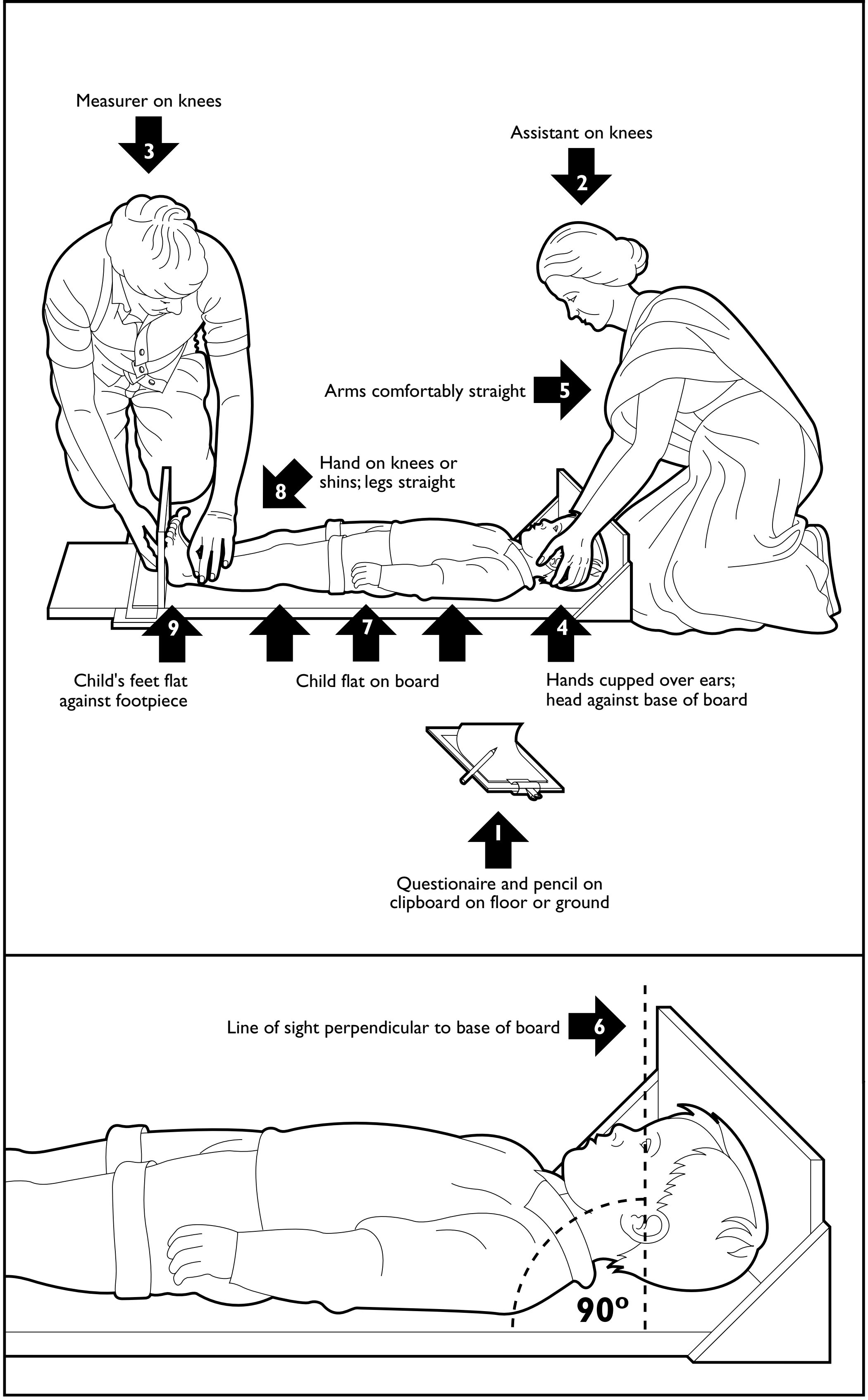
8. Measurer and assistant: Check the child's position (Arrows 1-9). Repeat any steps as necessary.

9. Measurer: When the child's position is correct, read and call out the measurement to the nearest 0.1 cm. Remove the foot piece and release your left hand from the child's shins or knees.

10. Assistant: Immediately release the child's head, record the measurement, and show it to the measurer.

11. Measurer: Check the recorded measurement on the questionnaire for accuracy and legibility. Instruct the assistant to erase and correct any errors.

Figure 5.2. Child Length Measurement - For Infants and Children 0-23 Months



Source: How to Weigh and Measure Children: Assessing the Nutritional Status of Young Children, United Nations, 1986.

5.3.4.a. Weight Using Salter-like Hanging Scale (*Figure 5.3*)

1. Measurer or assistant: Hang the scale from a secure place like the ceiling beam. You may need a piece of rope to hang the scale at eye level. Ask the mother to undress the child as much as possible.

2. Measurer: Attach a pair of the empty weighing pants to the hook of the scale and adjust the scale to zero, then remove from the scale.

3. Measurer: Have the mother hold the child. Put your arms through the leg holes of the pants (Arrow 1). Grasp the child's feet and pull the legs through the leg holes (Arrow 2). Make certain the strap of the pants is in front of the child.

4. Measurer: Attach the strap of the pants to the hook of the scale. DO NOT CARRY THE CHILD BY THE STRAP ONLY. Gently lower the child and allow the child to hang freely (Arrow 3).

5. Assistant: Stand behind and to one side of the measurer ready to record the measurement. Have the questionnaire ready (Arrow 4).

6. Measurer and assistant: Check the child's position. Make sure the child is hanging freely and not touching anything. Repeat any steps as necessary.

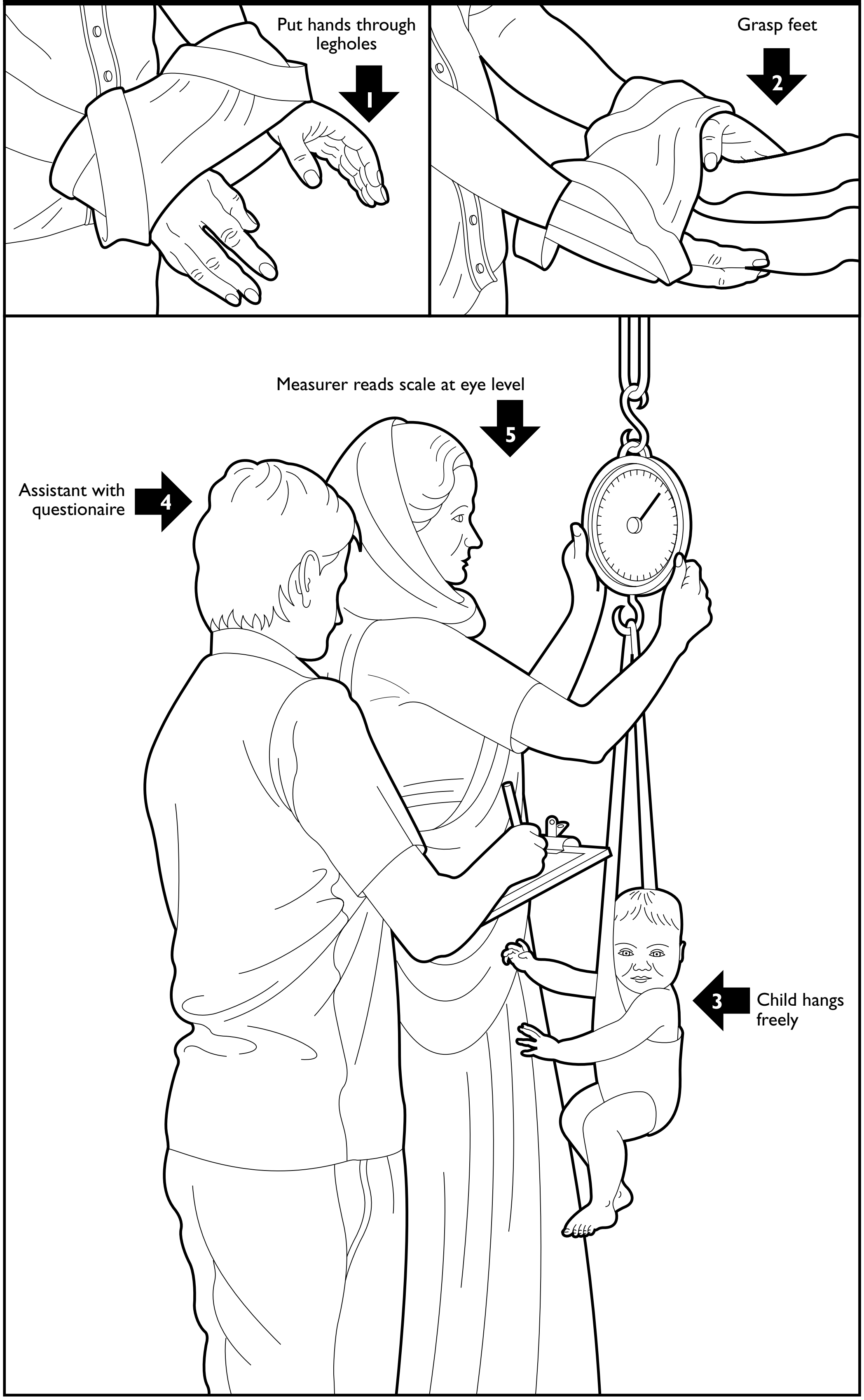
7. Measurer: Hold the scale and read the weight to the nearest 0.1 kg (Arrow 5). Call out the measurement when the child is still and the scale needle is stationary. Even children who are very active, which causes the needle to wobble greatly, will become still long enough to take a reading. WAIT FOR THE NEEDLE TO STOP MOVING.

8. Assistant: Immediately record the measurement and show it to the measurer.

9. Measurer: As the assistant records the measurement, gently lift the child by the body. DO NOT LIFT THE CHILD BY THE STRAP OF THE WEIGHING PANTS. Release the strap from the hook of the scale.

10. Measurer: Check the recorded measurement on the questionnaire for accuracy and legibility. Instruct the assistant to erase and correct any errors.

Figure 5.3. Child Weight Measurement Using Salter-like Hanging Scale



Source: How to Weigh and Measure Children: Assessing the Nutritional Status of Young Children, United Nations, 1986.

5.3.4.b. Child Weight Using UNICEF UNISCALE (*Figure 5.4*)

The UNICEF mother/child electronic scale (Item No. 0141015) requires the mother and child to be weighed simultaneously. Minimize the clothing on the child. Ensure the scale is not over-heated in the sun and is on an even surface enabling the reading to be clear. Ask the mother to stand on the scale. Record the weight and include the reading with one decimal point (e.g. 65.5 kgs). Pass the child to a person nearby. Record the second reading with just the mother (e.g. 58.3 kgs). The difference (e.g. 7.2 kgs) is the weight of the child. Refer to the UNICEF document "How to Use the UNISCALE" (June, 2000) prepared by the Nutrition Section Program Division/UNICEF New York. 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).

Figure 5.4. Child Weight Measurement Using Electronic Scale

Source: How to Use the UNISCALE, UNICEF, 2000.

5.3.5. Child Mid-Upper Arm Circumference (MUAC) Procedure (*Figure 5.5*)

1. Measurer: Keep your work at eye level. Sit down when possible. Very young children can be held by their mother during this procedure. Ask the mother to remove clothing that may cover the child's left arm.

2. Measurer: Calculate the midpoint of the child's left upper arm by first locating the tip of the child's shoulder (Arrows 1 and 2) with your finger tips. Bend the child's elbow to make a right angle (Arrow 3). Place the tape at zero, which is indicated by two arrows, on the tip of the shoulder (Arrow 4) and pull the tape straight down past the tip of the elbow (Arrow 5). Read the number at the tip of the elbow to the nearest centimeter. Divide this number by two to estimate the midpoint. As an alternative, bend the tape up to the middle length to estimate the midpoint. A piece of string can also be used for this purpose. Either you or an assistant can mark the midpoint with a pen on the arm (Arrow 6).

3. Measurer: Straighten the child's arm and wrap the tape around the arm at midpoint. Make sure the numbers are right side up. Make sure the tape is flat around the skin (Arrow 7).

4. Measurer and assistant: Inspect the tension of the tape on the child's arm. Make sure the tape has the proper tension (Arrow 7) and is not too tight or too loose (Arrows 8-9). Repeat any steps as necessary.

5. Assistant: Have the questionnaire ready.

6. Measurer: When the tape is in the correct position on the arm with the correct tension, read and call out the measurement to the nearest 0.1cm (Arrow 10).

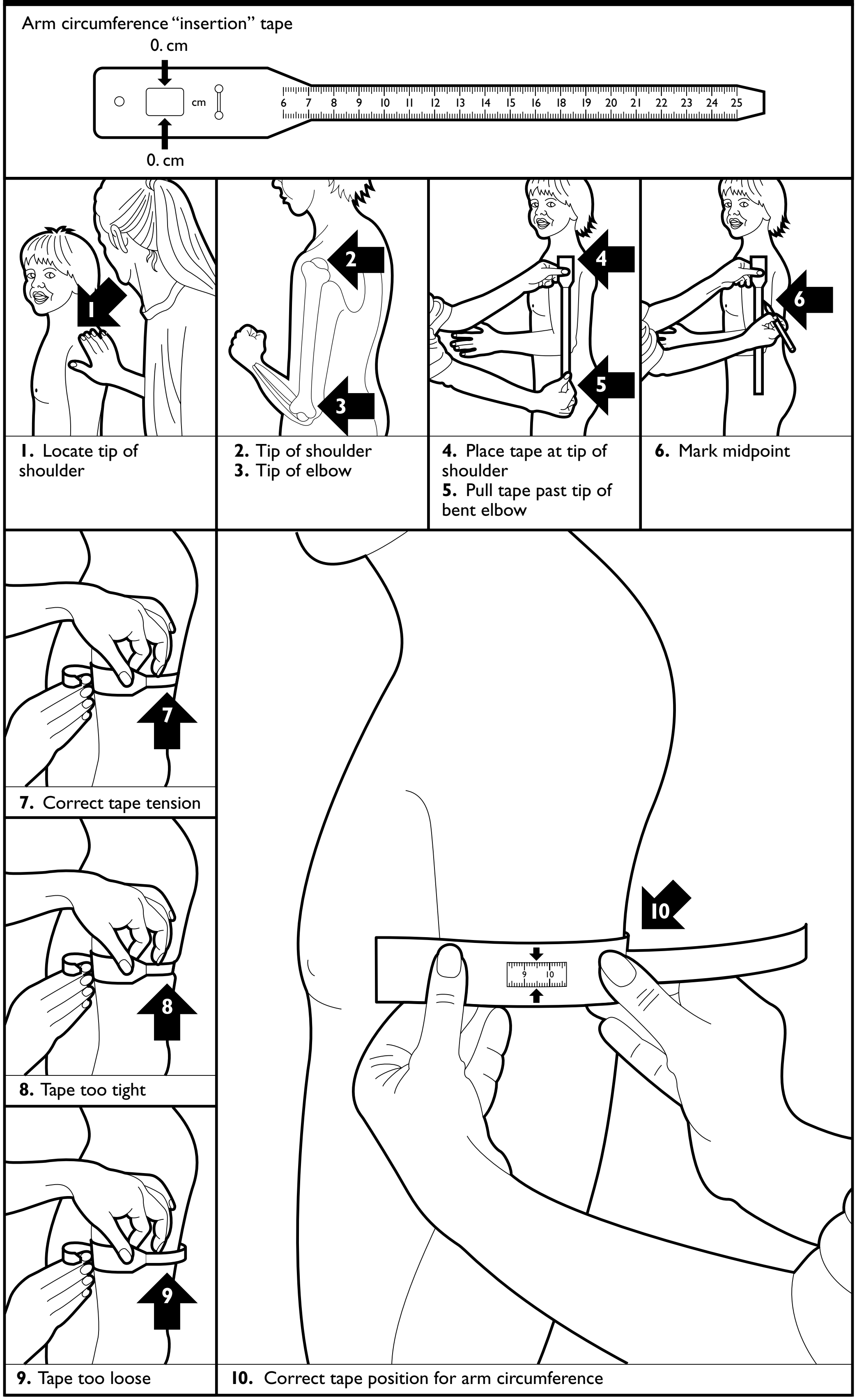
7. Assistant: Immediately record the measurement on the questionnaire and show it to the measurer.

8. Measurer: While the assistant records the measurement, loosen the tape on the child's arm.

9. Measurer: Check the recorded measurement on the questionnaire for accuracy and legibility. Instruct the assistant to erase and correct any errors.

10. Measurer: Remove the tape from the child's arm.

Figure 5.5. Child Mid-Upper Arm Circumference Measurement



1. Locate tip of shoulder

2. Tip of shoulder
3. Tip of elbow

4. Place tape at tip of shoulder
5. Pull tape past tip of bent elbow

6. Mark midpoint

7. Correct tape tension

8. Tape too tight

9. Tape too loose

10. Correct tape position for arm circumference

Source: How to Weigh and Measure Children: Assessing the Nutritional Status of Young Children, United Nations, 1986.

5.4. Assessing the Accuracy of Measurements

Accuracy is achieved through good training and supervision. There are techniques for measuring the accuracy of the measurements. When taking more than one height or weight measurement on the same person, the two measurements can be averaged. If they are vastly different from each other, the measurements should be disregarded and the measuring should start again (Table 5.1 provides specific parameters).

Table 5.1. Largest acceptable differences between repeated measurements

Anthropometric measurement	Largest acceptable difference
Weight	0.5 kg
Height	1.0 cm
MUAC	0.5 cm

The field supervisor is usually responsible for assessing the accuracy of measurements. There are a few practices a supervisor should employ to make sure that the data collected is of high quality. These are:

- Checking the measurements recorded and submitted by field staff, to see whether they look reasonable.

- Accompanying field staff on interviews to watch how measurements are taken.

- Conducting repeat visits to some households that have already been interviewed by the field staff. Measurements should be repeated to determine if the previous measurements are supported by the repeat measurements.

Appendix 6 has a section on Anthropometric Standardization tests. These tests can be used during training or at any point during the survey process to check how accurately field staff take measurements. These tests can be especially useful during training to determine who needs more training or who might need a little extra supervision once in the field.

5.5. Entering the Data

A survey questionnaire usually contains a wide range of information to be collected. A questionnaire should be adapted to the needs for measuring anthropometry. Some information will carry over from one module or section to another. The following is an example of one format used for survey work for children under five years of age.

Anthropometry: Basic information: Enter the children's names and identification code numbers, enter the sex and their ages (see Figure 5.6). Be careful not to mix up children when moving from one section of a questionnaire to another.

Child weight: Record the child's weight in kilograms to one decimal. Read the supporting notes carefully as they should be known to all interviewers and supervisors. In the example of Mary (Figure 5.6), her weight was 10.2 kilograms. Had her weight been 9.5 kgs, the entry would be |0|9:5|. Always note the zeros and the decimals.

Child length: Record the child's length in centimeters to one decimal. In the example of Mary (Figure 5.6), her length was 67.3 centimeters. The entry is made as |0|6|7:3|. Always note the zeros and the decimals. Make sure the information is entered accurately and fully on each child.

Figure 5.6. Child anthropometry questionnaire (partial)

Section 1: **Health and Nutrition** — Household ID: _ _ _ 0 1

1.1 Anthropometry — Date of interview: dd mm yy

Name	Child ID	Date of birth (dd/mm/yy)	Age (months)	Sex 1 = Male 2 = Female	Weight (kg 0.1)	Length (cms 0.1)
____	0 1	dd mm yy			:	:
____	0 2	dd mm yy			:	:

To the nearest 0.1kg and 0.1cm

For Example:
Mary, a girl, born on 7 August 1996, is approximately 11 months old and weighed 10.2 kilograms and was 67.3 centimetres long

Name	Child ID	Date of birth (dd/mm/yy)	Age (months)	Sex	Weight	Length
Mary	0 2	07 08 96 (dd mm yy)	1 1	2	1 0 : 2	0 6 7 : 3

5.6. Training Field Staff

Training field staff to collect anthropometric data through surveys usually involves learning to take anthropometric measurements and other skills such as household selection, interviewing techniques and recording requirements. All of these skills are important for conducting surveys that yield valid results. This section will cover what should be expected from field staff training.

5.6.1. Planning the training

It is recommended that you always select more candidates than you need. This will allow you to pick the candidates with the best performance when training is over and will give you some extra trainees in case of dropouts.

The length of the training will vary depending on the resources available and the complexity of the survey. As a guideline, training is generally scheduled for two to five days. Usually, the first day of training is spent explaining the purpose of the survey and outlining the survey procedures; the second and third days focus more closely on survey procedures and the questionnaire; and the last couple of days should be used for field exercises and tests. Field exercises will be covered in more detail later in this section.

The checklist below lists the topics that should be covered during training:

- Purpose and background of the survey;
- Organization of the survey team and division of responsibilities;
- Explanation of sampling and household selection procedures;
- Question-by-question review of the questionnaire;
- Instruction in techniques of interviewing, recording answers and checking out questionnaires;

- Explanation of specific nutrition indicators;
- Instructions on how to take and record anthropometric measurements and standardization tests (Also see Section 5.2 for information on ethically handling anthropometric data); and
- Administrative details (timetable, log-book, supplies, reports).

5.6.2. Field exercises and standardization

Survey staff should have ample opportunity to practice the skills taught during training. This is especially true with training on taking anthropometric measurements. Trainees' practical skills need to be developed. During practice sessions a supervisor can determine who needs more training. Practice sessions might begin by taking trainees to a school, maternal and child health clinic, hospital or orphanage and letting them practice taking children's measurements. The standardization exercises described in Appendix 6 ensure the trainees have acquired the necessary skills.

By the end of training, all trainees should also have had a chance to practice what they have learned. Choose a village that is close to the training center. The trainees should go through an entire survey with a few households and the supervisor should watch how each trainee performs. This will provide trainees with hands-on experience, make them feel more confident when they go into the field and will give the supervisor a chance to correct any mistakes.

5.6.3. Survey training manual

A training manual should give an overview of the purpose of the survey, an outline of the whole survey process and clearly define what is expected of the field staff. It can also include useful tips and answers to common questions that come up in the field. All field staff should be provided with their own copy of the training manual.

PART 6. Comparison of Anthropometric Data to Reference Standards

Comparing the measurements of children to reference standards is an easy procedure because of readily available, public-domain computer software. This section describes some underlying principles for efficient use of the available software, beginning with how individual measurements are compared to the reference standard.

6.1. NCHS/WHO Reference Standards

The reference standards most commonly used to standardize measurements were developed by the US National Center for Health Statistics (NCHS) and are recommended for international use by the World Health Organization. The reference population chosen by NCHS was a statistically valid random population of healthy infants and children. Questions have frequently been raised about the validity of the US-based NCHS reference standards for populations from other ethnic backgrounds. Available evidence suggests that until the age of approximately 10 years, children from well-nourished and healthy families throughout the world grow at approximately the same rate and attain the same height and weight as children from industrialized countries. The NCHS/WHO reference standards are available for children up to 18 years old but are most accurate when limited to use with children up to the age of 10 years. The NCHS/WHO international reference tables can be used for standardizing anthropometric data from around the world and can be found on FANTA's website at www.fantaproject.org/publications/anthropometry.shtml.

6.2. Comparisons to the Reference Standard

References are used to standardize a child's measurement by comparing the child's measurement with the median or average measure for children at the same age and sex. For example, if the length of a 3 month old boy is 57 cm, it would be difficult to know if that was reflective of a healthy 3 month old boy without comparison to a reference standard. The reference or median length for a population of 3 month old boys is 61.1 cm and the simple comparison of lengths would conclude that the child was almost 4 cm shorter than could be expected.

When describing the differences from the reference, a numeric value can be standardized to enable children of different ages and sexes to be compared. Using the example above, the boy is 4 cm shorter than the reference child but this does not take the age or the sex of the child into consideration. Comparing a 4 cm difference from the reference for a child 3 months old is not the same as a 4 cm difference from the reference for a 9 year old child, because of their relatively different body sizes.

Taking age and sex into consideration, differences in measurements can be expressed a number of ways:

- standard deviation units, or Z-scores
- percentage of the median
- percentiles

To standardize reporting, USAID recommends that Cooperating Sponsors calculate percentages of children below cut-offs as well as other statistics using Z-scores. If Z-scores cannot be used, percentage of the median should be used.

6.3. Standard Deviation Units or Z-Scores

Z-scores are more commonly used by the international nutrition community because they offer two major advantages. First, using Z-scores allows us to identify a fixed point in the distributions of different indices and across different ages. For all indices for all ages, 2.28% of the reference population lie below a cut-off of -2 Z-scores. The percent of the median does not have this characteristic. For example, because weight and height have different distributions (variances), -2 Z-scores on the weight-for-age distribution is about 80% of the median, and -2 Z-scores on the height-for-age distribution is about 90% of the median. Further, the proportion of the population identified by a particular percentage of the median varies at different ages on the same index.

The second major advantage of using Z-scores is that useful summary statistics can be calculated from them. The approach allows the mean and standard deviation to be calculated for the Z-scores for a group of children. The Z-score application is considered the simplest way of describing the reference population and making comparisons to it. It is the statistic recommended for use when reporting results of nutritional assessments. Examples of Z-score calculations are presented in Appendix 1.

The **Z-score** or **standard deviation unit (SD)** is defined as the difference between the value for an individual and the median value of the reference population for the same age or height, divided by the standard deviation of the reference population. This can be written in equation form as:

$$\textbf{Z-score (or SD-score)} = \frac{\textbf{(observed value) - (median reference value)}}{\textbf{standard deviation of reference population}}$$

6.4. Percentage of the Median and Percentiles

The percentage of the median is defined as the ratio of a measured or observed value in the individual to the median value of the reference data for the same age or height for the specific sex, expressed as a percentage. This can be written in equation form as:

$$\textbf{Percent of median} = \frac{\textbf{observed value}}{\textbf{median value of reference population}} \times 100$$

The median is the value at exactly the mid-point between the largest and smallest. If a child's measurement is exactly the same as the median of the reference population we say that they are "100% of the median." Examples of calculations for percent of median can be found in Appendix 1.

The percentile is the rank position of an individual on a given reference distribution, stated in terms of what percentage of the group the individual equals or exceeds. Percentiles will not be presented in this guide.

The distribution of Z-scores follows a normal (bell-shaped or Gaussian) distribution. The commonly used cut-offs of -3, -2, and -1 Z-scores are, respectively, the 0.13^{th}, 2.28^{th}, and 15.8^{th} percentiles. The percentiles can be thought of as the percentage of children in the reference population below the equivalent cut-off. Approximately 0.13 percent of children would be expected to be below -3 Z-score in a normally distributed population.

Z-score	Percentile
-3	0.13
-2	2.28
-1	15.8

6.5. Cut-offs

The use of a cut-off enables the different individual measurements to be converted into prevalence statistics. Cut-offs are also used for identifying those children suffering from or at a higher risk of adverse outcomes. The children screened under such circumstances may be identified as eligible for special care.

The most commonly-used cut-off with Z-scores is **-2 standard deviations**, irrespective of the indicator used. This means children with a Z-score for underweight, stunting or wasting, below -2 SD are considered moderately or severely malnourished. For example, a child with a Z-score for height-for-age of -2.56 is considered stunted, whereas a child with a Z-score of -1.78 is not classified as stunted.

In the reference population, by definition, 2.28% of the children would be below -2 SD and 0.13% would be below -3 SD (a cut-off reflective of a severe condition). In some cases, the cut-off for defining malnutrition used is -1 SD (e.g. in Latin America). In the reference or healthy population, 15.8% would be below a cut-off of -1 SD. The use of -1 SD is generally discouraged as a cut-off due to the large percentage of healthy children normally falling below this cut-off. For example, the 1995 DHS survey using a –2 SD cut-off for stunting in Uganda found a 36% prevalence of stunting in under-three year olds. This level of stunting is about 16 times the level of the reference population.

A comparison of cutoffs for percent of median and Z-scores illustrates the following:

90% = -1 Z-score
80% = -2 Z-score
70% = -3 Z-score (approx.)
60% = -4 Z-score (approx.)

6.5.1. Cut-off points for MUAC for the 6 - 59 month age group

MUAC cut-offs are somewhat arbitrary due to its lack of precision as a measure of malnutrition. A cut-off of 11.0 cm can be used for screening severely malnourished children. Those children with MUAC below 12.5 cm with or without edema are classified as moderate and severe.

Global Acute Malnutrition is a term generally used in emergency settings. The global malnutrition rate refers to the percent of children 6 to 59 months with weight-for-height below -2 Z-scores or 80% median or MUAC below 12.5 cm, with or without edema. This refers to all moderate and severe malnutrition combined. The combination of a low weight-for-height and any child with edema contributes to those children counted as in the global acute malnutrition statistic.

6.5.2. Malnutrition Classification Systems

The cut-off points for different malnutrition classification systems are listed below. The most widely used system is WHO classification (Z-scores). The Road-to-Health (RTH) system is typically seen in clinic-based growth-monitoring systems. The Gomez system was widely used in the 1960s and 1970s, but is only used in a few countries now. An analysis of prevalence elicits different results from different systems. These results would not be directly comparable. The difference is especially broad at the severe malnutrition cut-off between the WHO method (Z-scores) and percent of median methods. At 60% of the median, the closest corresponding Z-score is –4. The WHO method is recommended for analysis and presentation of data (see Part 6.2).

Mild, moderate and severe are different in each of the classification systems listed below. It is important to use the same system to analyze and present data. The RTH and Gomez classification systems typically use weight-for-age.

System	Cut-off	Malnutrition classification
WHO	< -1 to > -2 Z-score	mild
	< -2 to > -3 Z-score	moderate
	< -3 Z-score	severe
RTH	> 80% of median	normal
	60% - < 80% of median	mild-to-moderate
	< 60% of median	severe
Gomez	> 90% of median	normal
	75% - < 90% of median	mild
	60% - < 75% of median	moderate
	< 60% of median	severe

PART

7. Data Analysis

Computer software can be used to make comparisons to the reference standards. The Centers for Disease Control and Prevention (CDC) has developed a free software package called Epi Info that can handle all of these anthropometric calculations (www.cdc.gov/epiinfo). Cooperating Sponsors are strongly encouraged to use available software to analyze nutrition data. Not only will the software enable raw anthropometric survey data to be transformed into the indices and scores described in Part 6, the software will flag outliers which are usually the result of incorrect measurements, coding errors or incorrect ages. Once the anthropometric indices have been calculated, they can be presented in simple tables using specified cut-offs and age categories consistent with the Title II Generic Indicator list.

When using computer software for anthropometry, there are three separate procedures that should be performed. First, the raw measurement data should be entered into the computer. Second, the program should combine the raw data on the variables (age, sex, length, weight) to compute a nutritional status index such as weight-for-age, height-for-age or weight-for-height. Third, the program should transform these data into Z-scores so that the prevalence of nutritional conditions, such as being underweight and stunted, can be calculated.

Another software called ANTHRO analyzes anthropometric data and can be downloaded from the WHO Global Database on Child Growth and Malnutrition (www.who.int/nutgrowthdb).

There is another Windows-based software available from: www.nutrisurvey.de. This software program was designed specifically for nutrition surveys by the Work Group on International Nutrition of the University of Hohenheim/Stuttgart in cooperation with the German Agency for Technical Cooperation (GTZ). The software is based on the *Guidelines for Nutrition Baseline Surveys in Communities* published by GTZ. The purpose of the program is to integrate all steps of a nutrition baseline survey into a single program. The program contains a standard Nutrition Baseline questionnaire which can be easily customized for the specific site, a function for printing out the questionnaire, a data entry unit which controls the data being entered, a specially adapted plausibility check, a report function and a graphics section. The report function produces the full set of descriptive statistics of a baseline survey. The graphics section contains standard graphs and additional graphics for the anthropometric indices with comparison to the NCHS standard. The anthropometric indices (Z-scores of height-for-age, weight-for-height, weight-for-age) and the prevalence of stunting, wasting, underweight and overweight of children are calculated automatically. For further statistical evaluation, the data can be exported to SPSS or other statistical programs.

7.1. Sources of Epi Info Software

Public domain sources of Epi Info software and supporting materials. Epi Info is available from the Centers for Disease Control and Prevention (CDC), 1600 Clifton Road, Atlanta, GA 30333, USA or downloaded from: www.cdc.gov/epiinfo/.

The Epi Info 2002 package comes with a manual and tutorials to help the user to become familiar with data analysis using Epi Info.

7.2. Recommendation for Analysis and Presentation of Height Data

For evaluation purposes, the presentation of stunting data for children less than 24 months is useful. An intervention among children under 24 months is likely to be more effective than among children 24-59 months. This is because: 1) the determinants of stunting in the older children are more varied; and 2) stunting in older children may reflect historical nutritional or health stress and be 'permanent,' i.e. not responsive to any intervention. A further consideration in the presentation of data on stunting by age groups is the change in measurement technique at 24 months of age.

Prevalence. For use in Title II programs, the prevalence of nutritional status conditions can be calculated using cut-off points for height-for-age and weight-for-age. The cut-off points can be set using Z-scores, percentiles or percentage of the median. For Title II programs, a cut-off of -2 Z-score is recommended and results should be presented for both males and females. An example of a prevalence table for low height-for-age as established by -2 SD for groups of children aged 6 - 59.99 months is given below.

Table 7.1. Prevalence of low height-for-age (stunting) in a sample of 97 children, by sex and age group

Age Group (months)	Sex	Number below cut-off (-2 SD)	Number in age group	Percentage below cut-off
< 6	Boys	0	6	0.0
	Girls	0	4	0.0
	Combined	0	10	0.0
6-11.99	Boys	0	6	0.0
	Girls	0	3	0.0
	Combined	0	9	0.0
12-23.99	Boys	1	6	16.7
	Girls	2	10	20.0
	Combined	3	16	18.8
24-35.99	Boys	0	7	0.0
	Girls	4	13	30.8
	Combined	4	20	20.0
36-47.99	Boys	6	10	60.0
	Girls	3	10	30.0
	Combined	9	20	45.0
48-59.99	Boys	6	15	40.0
	Girls	5	7	71.4
	Combined	11	22	50.0
Total	Boys	13	50	26.0
	Girls	14	47	29.8
	Combined	27	97	27.8

Overall, this table shows that 26.0 percent of the boys had a low height-for-age or were stunted, while 29.8 percent of girls were stunted. Interpretations can also be made about the various age groups or with boys and girls grouped together.

7.3. Examples of Data Analysis

This section covers an analysis of data pertaining to maternal and child nutrition programs using food aimed at vulnerable groups in two populations (countries A and B), simulating situations often encountered in Title II operations. These examples illustrate an analysis that would allow one to reach, at a minimum cost, statistically valid conclusions concerning the nutritional impact of a supplementary feeding program.

The analysis compares the "before intervention" and "after intervention" data according to the following plan going from the general to the specific.

For all ages and sexes combined:

- all ages, both sexes comparison of change in the indicators;
- calculation of general prevalence of malnutrition (stunting and underweight);
- calculation of changes in prevalence.

Examination of data separated by sex (ages combined):

- calculation of general prevalence of malnutrition for each sex;
- calculation of changes in prevalence.

Examination of data by age categories (sexes combined):

- calculation of prevalence of malnutrition by age category;
- calculation of changes in prevalence.

With reference to this plan of analysis, the following assumptions should be noted.

- The final year evaluation measurements were taken after an interval sufficiently long for the program to have produced a nutritional impact (e.g. five years);
- Data were collected from a cross-sectional sample representative of the program population; and
- Baseline data had been collected.

The first example is a comparison of percentage or prevalence changes. Cooperating Sponsors are encouraged to compare changes in the mean Z-scores for statistical and epidemiological rigor.

Example 1

In 1995, a US-supported Cooperating Sponsor in cooperation with the Government of Country A, introduced a community-based health and nutrition program with a supplementary feeding scheme aimed at vulnerable groups. The scheme covered 6 of the 14 administrative districts of the country. Food supplements were distributed through community centers on a year-round basis to infants over six months of age and children up to the age of 3 years and to pregnant women and lactating mothers over an 18-month period (last 6 months of pregnancy and the first 12 months postpartum). In all, 86,000 individuals (21,000 women and 65,000 children) were covered by the program.

In agreement with the USAID Mission and Food for Peace (FFP), the Cooperating Sponsor decided to evaluate the nutritional changes at three intervals (baseline, mid-term and final year). The first collection of data began in the second year following the initiation of operations. By adopting a pre-post or reflexive design, data on sex, age, weight and height were collected from three representative cross-sectional sample surveys of the infant and child beneficiaries in 1996, 1998 and 2000.

Ages of the sample children ranged from 6 months to 5 years. Due to some problems in age estimations and incomplete data, sample sizes of the children varied between 3700 and 2500. No data were collected from the 8 districts in which the program had not been implemented. The population of the 8 districts was not comparable, from the nutritional and socioeconomic standpoints, with the population of the 6 districts covered by the program.

7.3.1. Calculation of Nutrition Levels

The measurement of nutritional impact was based on a comparison of data collected in 1996 and 2000 so that the figures would include the largest possible proportion of children who had participated in the program for one year or more. It was felt that this time interval was necessary to allow for any anticipated impact to manifest itself. The collected data are summarized in Table 7.5.

The results for weight-for-height are presented to illustrate that this indicator is inappropriate to evaluate the program since it reflects short-term changes. The tables also include age ranges that will not be used in the final presentation but Cooperating Sponsors are encouraged to examine the results for different age groups to better understand how the indicator responds.

Table 7.2. Distribution of nutritional indicators (Z-scores) at baseline (all ages)

	Height-for-age HAZ	Weight-for-age WAZ	Height-for-height WHZ
No. examined	2695	2695	2695
No. below -2 **SD**	1294	916	110
% below -2 **SD**	48.0	34.0	4.1

Table 7.3. Prevalence of low levels of nutritional indicators by sex at baseline (all ages)

	HAZ < -2	WAZ < -2	WHZ < -2
Girls	49.5	32.4	3.6
Boys	47.3	35.6	4.6

Table 7.4. Prevalence of stunting or low levels of height-for-age by age categories at baseline

	6-11 months	12-23 months	24-35 months	36-59 months
HAZ < -2	34.5	42.4	48.5	52.7
No. examined	560	523	534	1078

Table 7.5. Prevalence of low levels of nutritional indicators by sex and stage of intervention (for specific age categories)

	HAZ < -2 24-59 months		WAZ < -2 6-35 months		WHZ < -2 6-35 months	
	Baseline	Final year	Baseline	Final year	Baseline	Final year
Girls	49.5	35.5	32.4	23.1	3.6	3.2
Boys	47.3	37.5	35.6	26.5	4.6	4.0
Sexes combined	48.0	36.6	34.0	25.0	4.1	3.8

Tables 7.4 and 7.5 show that over the four years of the intervention, stunting in girls and boys was substantially reduced along with underweight. For sexes combined, the reduction was 11.4 and 9.0 percentage points for stunting and underweight, respectively. The reduction for stunting was more dramatic while wasting (WHZ) was virtually unaffected. Wasting should not be used for evaluation purposes as it is a relatively rare event and very susceptible to seasonal influences.

Note the different age groupings for stunting and wasting in Table 7.5. Some of the children measured for stunting were older than the children in the intervention. The reason for selecting the 24-59 month age group for evaluation was to capture the cumulative and lagged effect that the nutrition project would have on stunting.

There is another reason for the different age groupings. It is not recommended to aggregate data for children under 24 months with those over 24 months (see Part 7.2). Also, the Title II Generic Indicators recommend either stunting or underweight indices but require specific age groupings for underweight.

7.3.2. Comparison of Mean Z-scores

The alternative and preferred approach to evaluating the change in a percentage for a nutritional index is to compare mean Z-score change over the life of the program. Just as in the above calculation of change in prevalence of an index, the data are analyzed at baseline with the mean and standard deviation calculated and compared with the same project area in the final year of the program. The mean Z-score comparison has the advantage of describing the entire population directly, without resorting to a subset of individuals below a set cut-off. Comparing means over prevalences is desired as many of the Title II interventions target whole communities not just the severely malnourished.

A community health and nutrition intervention would expect all children to benefit, whereas a targeted feeding program for the severely malnourished would only benefit these children. Using a -2 SD cut-off and presenting a prevalence change would show a change in the prevalence of those below the cut-off. Therapeutic feeding programs would focus on changes in nutritional status among the severely malnourished but community based programs target all children and their caregivers. A presentation of the mean would reflect all the children and comparing means would reflect the community shift or improvement. The statistical comparison of mean Z-scores over time using the Student's T-test for example, is a more powerful statistical test than comparing prevalences using the Chi-square statistical test. Using the same example from above, Table 7.6 presents the results of the mean Z-scores for height-for-age and weight-for-age.

The evaluation recommendation for Title II programs is to use a comparison of mean Z-scores for statistical testing but the results should be presented with both change in mean Z-score and change in prevalence as the latter is more easily understood by a general audience.

Table 7.6. Mean Z-scores for stunting (HAZ) and underweight (WAZ) by sex and stage of intervention (for specific age groupings)

	HAZ 24-59 months		WAZ 6-35 months	
	Baseline	Final year	Baseline	Final year
Girls	-2.53	-2.33	-1.98	-1.54
Boys	-2.48	-2.45	-1.86	-1.65
Sexes combined	-2.50	-2.36	-1.93	-1.58

Example 2

A Cooperating Sponsor conducted a baseline and final-year survey collecting height and weight data on 24-59 month old children. At both times the sample was randomly drawn from the target communities and did not include the same children in both surveys. The pre-post design enabled a comparison of change in nutritional status (as reflected by height-for-age) in the target communities.

Baseline at time zero:

(t_0): Mean Z-score = -2.05 (sd=1.26); Prevalence (-2SD cut-off) = 40%
Sample size = 940

Final year at time five:

(t_5): Mean Z-score = -1.20 (sd=1.15); Prevalence (-2SD cut-off) = 23%
Sample size = 1056

Using statistical software to conduct the t-test (e.g. SPSS, or STATA; note that Epi Info 2000 or Epi Info 6 does not have this test), the testing of the significance of the change in the sample means is straightforward.

t = (Mean t_0 - Mean t_5) / sq. root (Variance t_0/n_0 + variance t_5/n_5)

where n_0 and n_5 is sample size at baseline and final year.

t = (-2.05 - (-1.20)) / [sq. root ((1.26x1.26)/940)) + ((1.15x1.15)/1056))]
t = (-0.85) /[sq. root (0.0016889) + (0.0012523)]
t = (-0.85) /[0.054233]
t = 15.67

This change in mean Z-scores is highly significant (i.e. well above the critical t-value of 1.96 at 0.05 level).

7.4. Additional Data Analysis Information

In cooperation with Food Aid Management, FANTA developed a workshop for the training of program managers in the calculation and analysis of basic anthropometric data using Epi Info and SPSS (Statistical Package for Social Sciences). The materials from the Data Analysis Workshop are available at: www.fantaproject.org under Monitoring and Evaluation.

Step-by-step instructions on data analysis can be found on the Practical Analysis of Nutritional Data (PANDA) website: www.tulane.edu/~panda2/. PANDA was designed for data analysis instruction using SPSS software.

There are many statistical analysis software packages available, other than Epi Info. The packages listed below are only a few of the commonly used statistical analysis software programs. These packages vary in capability and cost. Information on capability and ordering the packages can be found on their websites.

SPSS (Statistical Package for Social Sciences) www.spss.com
SAS (Statistical Analysis System) www.sas.com
STATA (Statistics/Data Analysis) www.stata.com
SUDAAN (Software for the Statistical Analysis of Correlated Data)

Annual Monitoring Indicators

PART 8.

8.1. Introduction

Information from regular reporting of activities from growth monitoring and promotion programs (GMP) will enhance program management and can provide valuable insights into the interpretation of anthropometric indicators of impact that is required by USAID. This section describes how annual monitoring indicators that are based upon data from monitoring may be collected and reported in a standard format. This will help make the indicators more useful for management of programs at all levels within countries and for reporting to USAID. Reporting information to USAID on annual monitoring indicators is recommended but not required.

The recommended annual monitoring indicators for maternal and child health and nutrition programs are:

- Percent of eligible children in growth monitoring and promotion (GMP);

- Percent of children in GMP program gaining weight in past 3 months (gender specific).

8.2. Routine Data Collection

These guidelines are designed to avoid any unnecessary burden of reporting on staff at all levels in program implementation and so information for the monitoring indicators should come from routinely collected data rather than special surveys. At this time, there is not a standard format for collecting data from GMP activity and the indicators that are available will vary widely among Cooperating Sponsors and countries, and in some cases, within the same Cooperating Sponsor. It is appropriate to report whatever data are readily accessible and avoid investing scarce resources in attempts to generate or retrieve data that are not readily accessible.

Data needed for the first index, GMP attendance rate:

1. **The denominator:** the number of eligible children in the population, by gender and age (usually the most reliable estimates will be those the project has gathered as part of its baseline survey, or other data collection activities);

2. **The numerator:** the number of children in growth monitoring/promotion. The classification of "in growth monitoring and promotion" is meant to reflect the total number of children whose weight has been monitored in clinic- and/or village-based activities. This number may be the total number of children weighed in the 'round' immediately before the reporting period, or it may be an estimate of the usual total number of children attending weighing activities over the reporting period.

How the number is derived is not necessarily important, but it is most important to report clearly how the estimate was made. Because attendance at GMP programs varies widely with age, this number will be more meaningful if it is age specific – e.g., <12 months, 12 - <24 months, 24 - <60 months (ages reported will be influenced by the target age group of the project).

The definition of the numerator of the first index is central to the definition of the second index. Data needed for the second index, GMP increased weight rate among enrolled children:

1. **The denominator:** this will be the same as the numerator from the first index, i.e. the total number of children attending growth monitoring/promotion; and

2. **The numerator:** the number of children in growth monitoring/promotion who gained weight in the last 3 months. Two elements should be considered but the direction of weight change is more important than the second concerning the 3-month time frame.

The reports of many weighing activities, both clinic- and village-based, include a summary that presents a) the total number of children attending, b) the number of children who gained weight, and c) the number of children who did not gain weight. All children weighed should be classified as either gaining weight or not gaining weight – usually over a 3 month period. Calculate the index by dividing the number of children who gained weight by the total number of children attending, then multiply this by 100. This index should be considered available only in those programs in which the appropriate summary numbers are reported. In some situations, a time frame other than 3 months is the only available information.

Collecting accurate data from weighing is difficult. To ensure the quality of the data, health workers should be properly trained to make accurate measurements of whether or not a child is gaining weight. Data from assessments are central to the usefulness of growth monitoring and promotion programs.

Annual benchmarks are not appropriate for these indicators because their interpretation is specific to the context of the particular program and its activities. For example, when a program extends activities into areas of highest need (perhaps because of remoteness or food insecurity), the overall percent of children in growth monitoring and promotion and the percent of children gaining weight are likely to decrease. Clearly this result will not be interpreted as reflecting poorly on program implementation. This example demonstrates that the monitoring indicators proposed here could not be interpreted independent of the context of the activities of a program. These indicators are not useful for summative evaluation and are not intended to be used for this purpose.

Substantial resources should not be invested to gather data on annual monitoring indicators reported by Cooperating Sponsors. However, it is recommended that Cooperating Sponsors consider the advantages of including the monitoring indicators in their annual reports and to modify training, implementation and information management systems to incorporate these indicators in the future.

8.3. Data on Growth Monitoring and Promotion

Relevant items could be added to questionnaires at baseline and end-line to describe changes over the time period of an intervention (provides an assessment of impact of the intervention on service delivery that might help support or explain findings from anthropometric status of children).

Resources on GMP are available in a Diarrhea Dialogue supplement on Growth Monitoring Health Basics: Issue no. 24, March 1986 at: www.nand.org/dd/html/su24.htm.

PART

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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

2. Uses of Anthropometric Data

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.

Selecting a Sample

APPENDIX 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 $Z_ß$
.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

5. APPENDIX

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								
	VALUE – Supervisor								
	VALUE – 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 Empty Circle	Whole Circle	No 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 3 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 24.7 — Correct 24.7

4. Number single digits 1-9 as follows: Ø8 or ØØ8

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
☐92.☐	☐92.Ø	92Ø.☐	Ø92.Ø

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

APPENDIX

7. Guidelines for Supervising Surveys

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