A USER'S MANUAL FOR

CONDUCTING CHILD NUTRITION SURVEYS IN DEVELOPING COUNTRIES

Victoria J. Quinn

The Cornell Food and Nutrition Policy Program (CFNPP) was created in 1988 within the Division of Nutritional Sciences, College of Human Ecology, to undertake research, training, and technical assistance in food and nutrition policy with emphasis on developing countries.

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ABBREVIATIONS

CDC	—	Centers for Disease Control
NCHS	—	National Center for Health Statistics
NHSCP	—	National Household Survey Capability Programme
SD	—	Standard Deviation
UNICEF	—	United Nations International Children's Emergency Fund
UNIPAC	—	UNICEF Procurement and Assembly Centre
UNSO	—	United Nations Statistical Office
WH	—	Weight-for-Height
WHO	—	World Health Organization

FOREWORD

Data from household surveys are frequently used in quantitative analyses related to food and nutrition. Unfortunately, a significant share of such analyses result in faulty information because the surveys were poorly done. The problem of large measurement errors in data from household surveys needs to be alleviated through better planning and execution of the surveys. In an attempt to assist in future survey planning and execution, Victoria Quinn discusses in this working paper a number of issues critical to ensuring high quality of data collected in child nutrition surveys in developing countries. The paper is organized as a user's manual to facilitate in planning as well as actual execution of child nutrition surveys.

This working paper complements a series of working papers on various other aspects of food and nutrition-related household surveys published jointly by CFNPP and the Department of Agricultural Economics, Cornell University. Since the readers may be interested in consulting some of these working papers, a list is presented below:

Paper Subject	**Series Number**	**Author**	**Author's Country of Study***
Rural Household Data Collection in Developing Countries: Designing Instruments and Methods for Collecting Household Information Data	91-13	Krishna B. Belbase	Nepal
Rural Household Data Collection in Developing Countries: Designing Instruments and Methods for Collecting Consumption and Expenditure Data	91-14	Carol Levin	Indonesia
Rural Household Data Collection in Developing Countries: Designing Instruments and Methods for Collecting Health and Nutrition Data	91-15	Jan Low	Northern Malawi
Rural Household Data Collection in Developing Countries: Designing Instruments and Methods for Collecting Time Allocation Data	91-16	Julie P. Leones	Philippines

Rural Household Data Collection in Developing Countries: Designing Instruments and Methods for Collecting Farm Production Data	91-17	Scott Rozelle	China
Rural Household Data Collection in Developing Countries: Designing Instruments and Methods for Collecting Off-Farm Income Data	91-18	Leones & Rozelle	Philippines, China
Rural Household Data Collection in Developing Countries: Designing Instruments and Methods for Preparing the Data for Analysis	91-19	Tom Randolph	Southern Malawi

* Each paper includes examples from other studies along with those from the author's country of study.

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Ithaca, New York
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Per Pinstrup-Andersen
Director, CFNPP

1. INTRODUCTION

This field manual is intended to provide a step-by-step user's guide on how to conduct a child nutrition survey in a developing country with the focus on malnutrition. The manual has been written for a nontechnical audience with little or no experience in data collection of this type. Attention is given to collecting the minimum amount of information necessary to determine the nutritional status of children under the age of five years. This includes techniques on collecting, processing, and analyzing data on weight and height, the two measurements most widely used to determine nutritional status.

There are other aspects of conducting nutrition surveys, including sampling design and questionnaire content, which are beyond the scope of this manual, as they are highly survey specific and greatly depend on the objectives of each survey. Although not discussed here, these types of issues are very important and must be adequately addressed by persons knowledgeable in these areas during the early stages of survey preparations.

This field manual is for routine, nonemergency child nutrition surveys. Since nutritional emergencies require a rapid assessment of the situation, certain techniques may be better suited for detecting quickly and simply the levels of malnutrition in a large number of children under famine conditions, including the use of mid-upper arm circumference measuring tapes or the Thinness Chart. The assessment of nutritional status under emergency conditions requires a different approach than that which is presented in this manual, and the interested reader is referred to other manuals on this specialized subject by UNICEF (1986) and Appleton (1987).

The different aspects of conducting a child nutrition survey, which will be covered in this field manual, in order from start to finish include:

2. Overview of Anthropometric Indicators
3. Measuring Age, Weight, and Length
4. Organizing the Survey
5. Collecting the Data and Quality Control
6. Processing and Analyzing the Data
7. Presenting Data on Nutritional Status
8. Preparing the Final Report

2. OVERVIEW OF ANTHROPOMETRIC INDICATORS

In developing countries the nutritional status of children under the age of five years is considered to provide a good reflection of the nutritional well-being of the community. This is because children are the most vulnerable to problems of inadequate food intake and disease, the major underlying causes of malnutrition. Before discussing the steps of conducting a child nutrition survey, it is useful to introduce some basic concepts and terms of anthropometric indicators of nutritional status.

Anthropometry literally means *human measurement*, and measurements of weight and height, combined with data on age and sex, provide the basic information needed to assess a child's nutritional status. To use measurements of weight and height, these raw values first must be "transformed" into the nutritional indicators of weight-for-height, height-for-age, and weight-for-age. A summary of the meaning of these indicators as they are commonly used in developing countries is given as follows.

WEIGHT-FOR-HEIGHT

It is commonly accepted that weight-for-height is a good indicator of a child's present nutritional status, and children with low weight-for-height values are termed nutritionally wasted. Weight-for-height is an indicator that is particularly important for the description of the current health status of a child.

HEIGHT-FOR-AGE

Height-for-age on the other hand is a good indicator of past nutritional status, and children with low height-for-age values are termed nutritionally stunted. Deficits in height reflect overall social conditions (e.g., access to food, income, childcare practices, health levels, and sanitation facilities). Therefore, height-for-age is considered to be a good indicator of overall socioeconomic conditions.

WEIGHT-FOR-AGE

A common indicator frequently used by health staff is that of weight-for-age, and children with low weight-for-age values are termed underweight. Weight-for-age provides a mixed reflection of nutritional status since it encompasses both the weight contributed by muscle and fat mass and that contributed by skeletal mass.

3. MEASURING AGE, WEIGHT, AND LENGTH

AGE

The focus of this field manual is on determining the nutritional status of children between the ages of 0 to 59 months. In many rural areas of developing countries, it is difficult to determine the age of children because of the lack of birth records and official documents. If this is the case, a *local events* calendar will need to be designed by the organizers of the survey to pinpoint the dates (month and year) of major events in the previous five years. The year can best be determined by major events such as droughts, floods, festivals, and elections. The month can be determined by matching the birth with seasonal factors such as the dry season, the long rains, the short rains, the maize harvest, and so on. The actual month and year of birth must be recorded, and, if possible, the day as well. In addition, the date of the interview when the child was measured must also be recorded on the questionnaire in order that the precise age of the child can be calculated later during the data processing stage after the questionnaires have been entered into a computer. Never rely on the enumerators to calculate the age of the child in the field as this is very prone to error.

If it is impossible to determine age accurately, then it is advisable to select all children with length measurements of 120 centimeters or less. Chances are that most of them will be under five years of age. Under these circumstances, only the indicator weight-for-height can be determined as it does not require age data.

HOW TO COLLECT WEIGHT AND LENGTH MEASUREMENTS

Accurate weight and length measurements are essential to a successful nutrition survey. It is important that not only the enumerators but also the supervisors know the procedures. It is also important that the mother or guardian of the child understands why the measurements are being taken in order to reassure them and get their cooperation during the interview. Taking weight measurements requires a single enumerator. Taking length measurements requires two enumerators working together as a team.

Children should be measured after all the questionnaires have been administered to the mother or guardian, with first weight and then length being taken. This approach will give the enumerators time to get to know the family as well as the children. If there is more than one eligible child in a household, it is better to begin with the oldest child and complete all the measurements of one child at a time before taking measurements of any other child. This avoids the confusion that could result if all the children are measured at the same time, since measurements become mixed up and the wrong values put down for the wrong children. It is also not advisable to weigh or measure children if they appear to be sick or upset, if the mother refuses, or if the child has a deformity that would invalidate the measurement, especially length (e.g., rickets, polio, etc).

The basic techniques for measuring weight and length are summarized below. Additional descriptions of these measurement techniques are described in UNSO/NHSCP (1986) and Martorell (1982).

WEIGHT

All children between 0 and 59 months should be weighed. A portable hanging scale with a maximum capacity of 25 kilograms and demarcations at every 100 grams (Figure 1) is the preferred instrument for weighing children in field surveys as it is easy to carry, durable, and accurate. In addition, most can be adjusted to zero with a screw knob. These scales can be ordered from UNIPAC, the United Nations Children's Fund supply office in Copenhagen. Each hanging scale usually comes supplied with a set of plastic weighing trousers. Other companies offer similar equipment, and Appendix A provides a lists of these companies and their addresses. Bathroom type scales are not recommended for field surveys because of their lack of accuracy and problems with dust and dirt, which may ruin the calibration of the internal spring mechanism.

The hanging scale should be suspended at eye level with a rope from either a beam, a low branch of a tree, a specially made weighing tripod or a crossbar held by two people. Alternatively, the scale can be held manually by one enumerator if it cannot be hung. If the scale is held manually, the child should be lifted with as much vertical takeoff as possible, and the final position of the scale should be parallel to the enumerator at eye level. The procedure for taking weight measurements is given in Figures 2 and 3.

As described in Figure 2, each enumerator should independently read the child's weight to the nearest tenth of a kilogram. The two weight values should not differ by more than 0.5 kilogram. If they do differ by more than this amount, further measurements should be taken to determine the closest pair of weight values that then can be recorded on the questionnaire. Later during the processing of the data, the average value of the two weight measurements will be used.

LENGTH

After a child is weighed, the enumerators should immediately measure the child's length. Experience has shown that in child nutrition surveys in rural areas, it is easier and more accurate to measure a child while recumbent than while standing. Straight walls and flat floors are not common in rural

Figure 1 — A Portable Hanging Scale

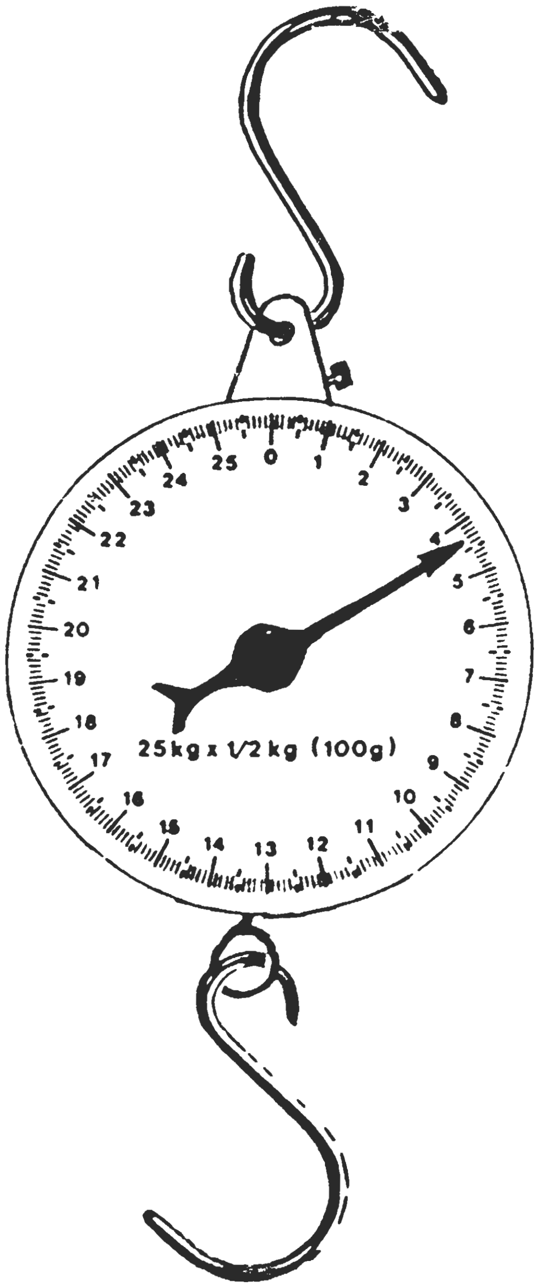


Figure 2 — Procedure to Measure Weight

1. **Enumerator A:** Hang the scale from a tree branch or ceiling beam with a piece of rope. Make sure that the scale is at eye level. Enumerator B should undress the child with the mother's help.

2. **Enumerator A:** Attach a pair of empty weighing pants to the hook of the scale and adjust the scale to "zero," then remove from the scale. Small infants can be weighed in a piece of tied cloth.

3. **Enumerator A:** Have Enumerator B hold the child. Enumerator A puts his arms through the leg holes of the pants **(arrow 1)** and grasps the child's feet to pull them through the leg holes **(arrow 2)**. Make certain that the strap of the pants is in front of the child.

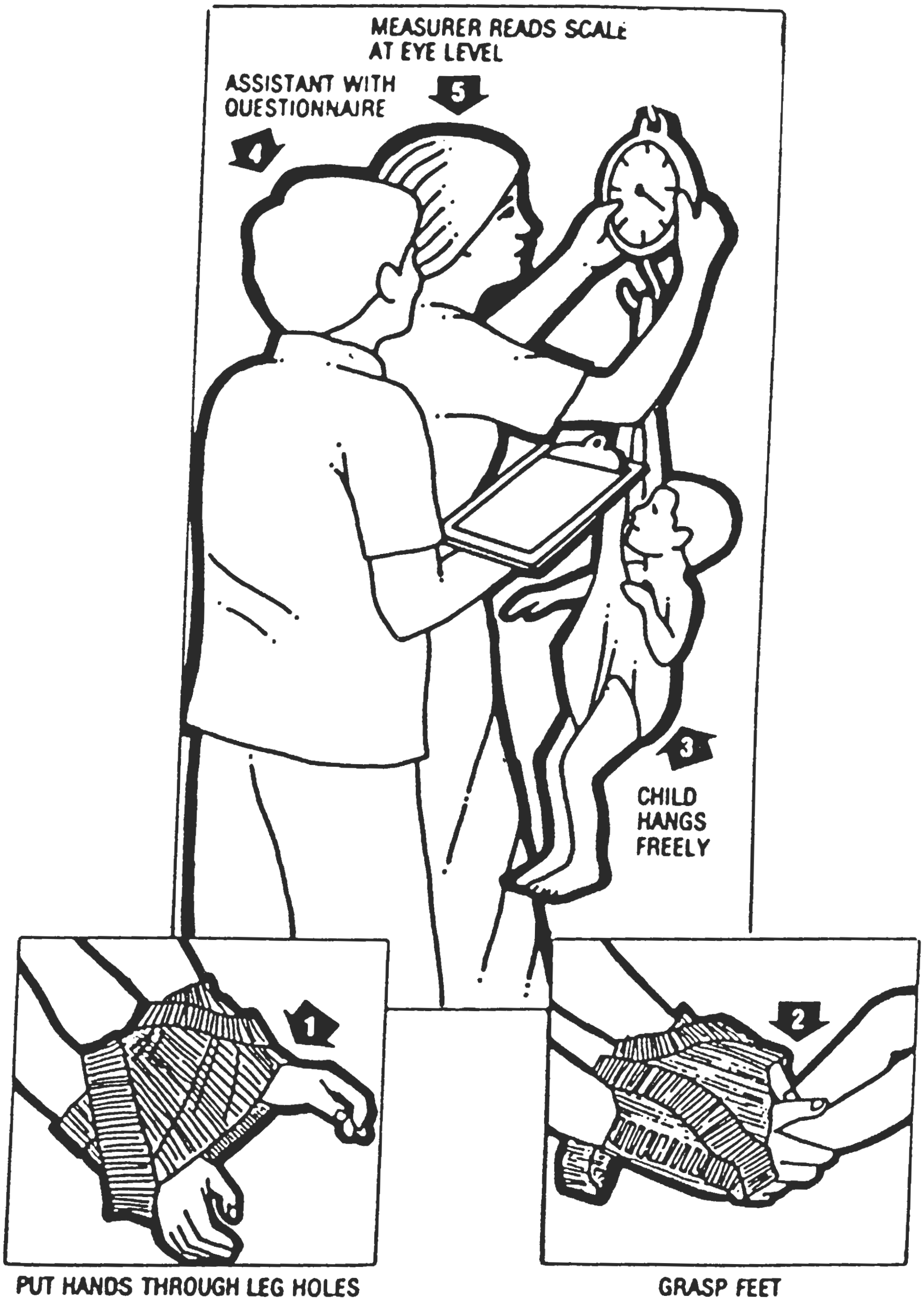
4. **Enumerator A:** Hold the child and attach the strap of the pants to the hook of the scale. Do not carry the child by the strap only. Gently lower the child and allow the child to hang freely **(arrow 3)**.

5. **Enumerator A:** Check the child's position by making sure the child is hanging freely and not touching anything. Repeat any steps as necessary.

6. **Enumerator A:** Hold the scale and once the needle has stopped moving read the weight measurement silently to the nearest 0.1 kilogram. Immediately record the measurement on the questionnaire to the nearest 0.1 kilogram. **Enumerator B** should not see the measurement.

7. **Enumerators A and B should switch positions. Enumerator B now reads the weight value out loud.** If the measurements differ by more than 0.5 kilogram, they should be repeated until the two values are within 0.5 kilogram of each other. The final two values should be recorded on the questionnaire.

Figure 3 – Weighing a Child



Source: UNSO/UNHSCP (1986).

households. Since recumbent length is not exactly equal to standing height, a conversion factor needs to be applied to the raw length measurements to approximate height. This is discussed in detail below under the section on Converting Length to Height. For simplicity sake, reference will be made throughout this manual to height even though the actual measurement taken is length.

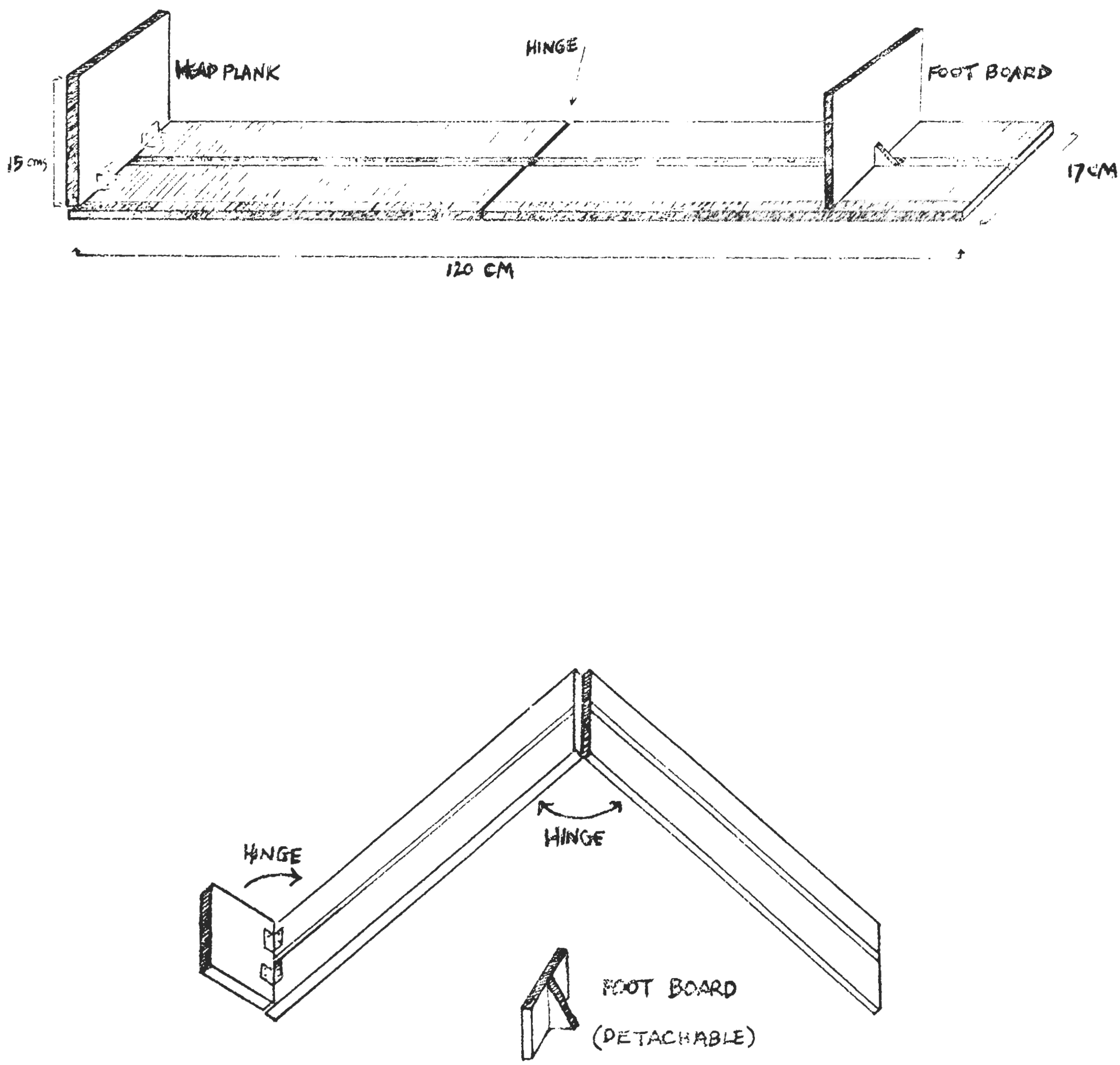
The mother may be required to assist more actively in taking this measurement to comfort the child and to help hold it down on the length board if the child resists. Infants younger than 3 months of age may be excluded from having their length measurements taken because of the difficulty in straightening out their small legs to get an accurate reading. For similar reasons, some researchers even raise this age limit to 6 months and only measure length on children 6 to 59 months. The choice is up to the organizers of the survey.

A standard design for constructing a child length board is shown in Figure 4. These boards can also be purchased ready-made (see Appendix A); however, the costs may be higher than if the boards are made locally. For locally made boards, it is important that the wood used does not warp with age, that the tape measures are easy to read and have the centimeter number marked right next to the line to ensure accuracy when reading the measurement. The tape measures should be made of fiberglass and not plastic as the latter tends to stretch. The length board should be at least 120 centimeters long. In addition, the length boards should have hinges to allow them to be collapsed in half for ease of carrying. The hinges should be wide and broad enough so they do not bend under pressure. Also, the screws used need to be long enough so that they cannot be pulled out if the hinges are strained. The length board should also have an indented grooved track, about 1 centimeter deep by 1 centimeter wide, extending from the head plank down to the foot end of the board. A sliding foot piece that has a "tooth" that snugly fits into the grooved track can be firmly held against the bottom of the child's feet in order to read the length measurement.

Some children are very uneasy about having their length measurements taken, and in such cases the enumerators must help to calm the child and reassure the mother. Parents are sometimes suspicious that the child is being measured for a coffin. Dispelling these types of anxieties will help ensure a successful interview. This will depend on the enumerators thoroughly explaining the purpose of the measurements to reassure the mother. In addition, enumerators who are confident and take measurements with self-assurance and swiftness are more likely to be successful in measuring distressed children. The procedure to take length measurements is shown in Figures 5 and 6.

As described above in Figure 5, each enumerator should take independent readings of length measurement to the nearest tenth of a centimeter. The two readings should not differ by more than 0.5 centimeter. If the readings do differ by more than this amount, the child's length should be measured again to determine the closest pair of length values, which should then both be recorded on the questionnaire. Later during the processing of the data, the average value of the two length measurements will be used.

Figure 4 – Design for Locally Made Length Board



Drawn by E. Ni' Chleirigh

Figure 5 — Procedure to Measure Length

1. **Enumerator A:** Place the measuring board on a hard flat surface. Put pencil or pen with the clipboard and questionnaire on the ground within reach.

2. **Enumerator B:** Kneel with both knees behind the head plank of the board **(arrow 2).**

3. **Enumerator A:** Kneel on the right side of the child to easily read the tape measure as well as hold the sliding foot piece with the right hand **(arrow 3).**

4. **Enumerator A and Enumerator B:** With the mother's help the child should be lowered onto the board by doing the following:

   Enumerator B: Support the back of the child's head and gradually lower the child onto the board.

   Enumerator A: Support the child at the trunk of the body.

5. **Enumerator B:** Cup hands over the child's ears **(arrow 4).** With arms comfortably straight **(arrow 5),** place the child's head against the base of the head plank so that the child is looking straight up. Bulky hair needs to be compressed so that top of the child's head is touching the head plank. The child's line of sight should be perpendicular to the ground **(arrow 6). Enumerator B's** head should be straight over the child's head looking directly into the child's eyes.

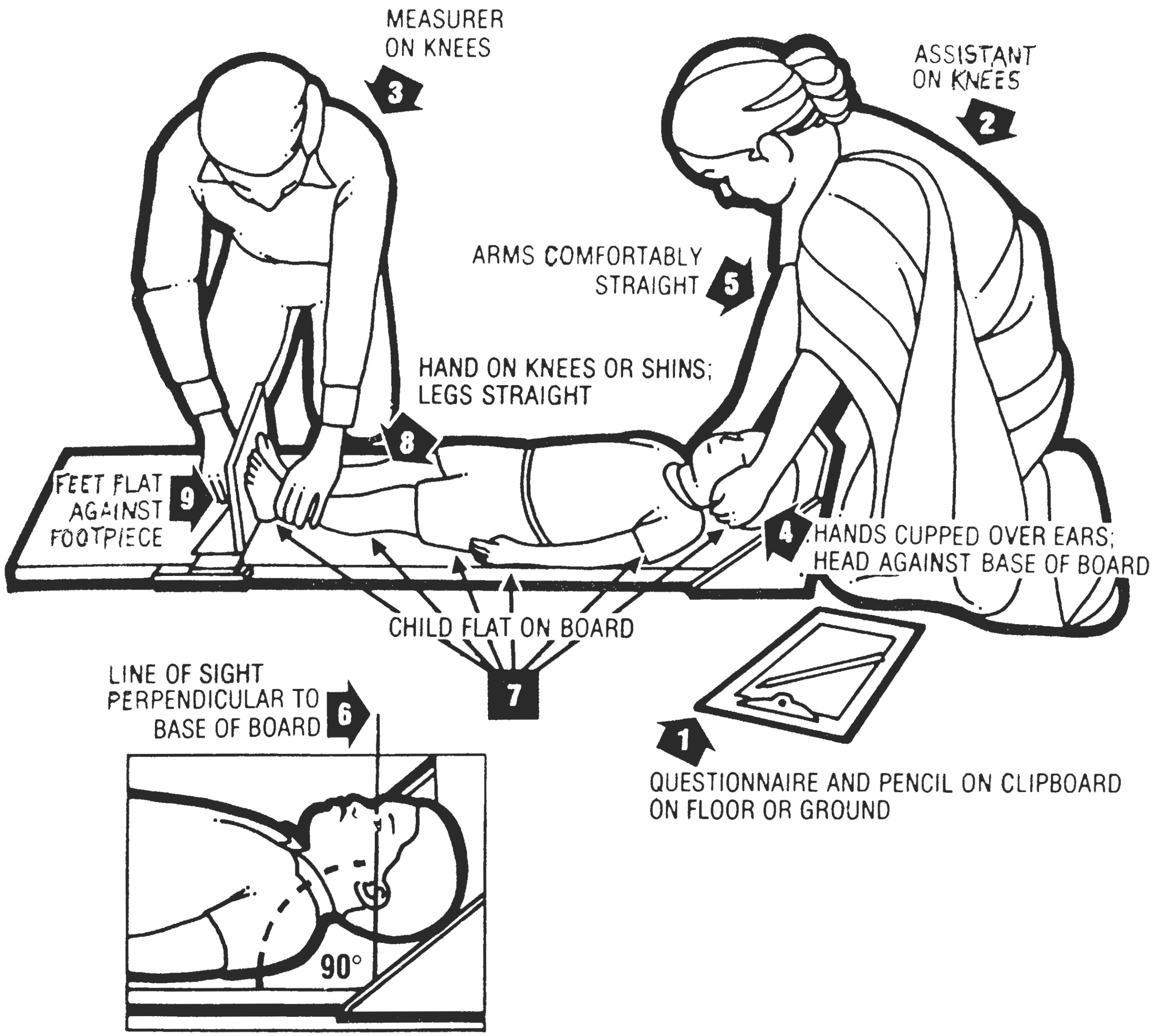
6. **Enumerator A:** Make sure the child is lying flat and in the center of the board **(arrow 7).** If the child is very distressed, have the mother help to hold the child's hands down as well as hold the trunk of the child flat and straight on the length board. Check that **Enumerator B** is holding the child's head in the correct position.

7. **Enumerator A:** When the child is in the correct position, **Enumerator A** should place his left hand on the child's shins (above the ankles) or on the knees **(arrow 8)** and press them firmly down against the board. With his right hand, he should push the foot piece firmly against the child's heels **(arrow 9).**

8. **Enumerator A:** When the foot piece is firmly pressed flat against the child's heels, **Enumerator A** should silently read the measurement to the nearest 0.1 centimeter and **immediately** record it on the questionnaire without letting **Enumerator B** see it.

9. **Enumerator A and B** should switch positions and repeat the above procedure (steps 1 through 9). This time **Enumerator B** should read the length measurement out loud and if it differs by more than 0.5 centimeter of the first measurement, the procedure should be repeated until the two values are within 0.5 centimeter of each other. Both values should be recorded on the questionnaire.

Figure 6 – Taking Length Measurement



Source: UNSO/UNHSCP (1986).

4. ORGANIZATION OF THE SURVEY

The making of a successful field survey begins with ensuring that the organization of the exercise is well-planned from the start. If not enough attention is given to some basic essential details, problems are inevitable. Prior to the start of any survey, an overall time schedule from start to finish should be prepared in addition to a basic checklist of things to be done, sometimes well in advance of the survey date. Some of the more important items include

(1) obtaining enough of the right type of equipment
(2) hiring enumerators and supervisors
(3) training the enumerators and supervisors
(4) formatting the questionnaire
(5) conducting the pretest
(6) conducting pilot exercises
(7) making other arrangements
    (a) arranging transport/accommodation of field staff
    (b) obtaining clearance to conduct the survey
    (c) notifying local leaders about the survey.

EQUIPMENT

The type of equipment required for the survey must be organized well ahead of time, especially if it needs to be ordered from overseas, which is often the case in developing countries. When overseas procurement of measuring equipment is necessary, at least six months forward planning time is typically needed. Each team of enumerators will need a child weighing scale, a set of weighing trousers, a rope with which to hang the scale, and a child length board. Basic supplies for each enumerator, such as pens, pencils, erasers, clipboards, carrying bags, paper clips, and stationery, also need to be included on the equipment list.

ENUMERATORS AND SUPERVISORS

The quality of the data collected will very much depend on the quality of the enumerators and supervisors who are employed, in addition to the training given to them. Enumerators must be literate and have a basic educational qualification, preferably a secondary school certificate. University graduates are good as long as they are prepared to endure the rigors of field work. Either men or women can be employed, unless local cultural taboos affect their ability to conduct the field work. If at all possible, try to hire individuals who are used to hard work and lots of walking, and who have field survey experience.

The enumeration staff from national statistical offices may be a good choice, especially if a lull in their survey schedule allows them time to conduct a nutrition survey. Utilizing health staff has its advantages and disadvantages. The major advantage is that health staff are used to handling children and asking technical questions. However, related to this is the main disadvantage of retraining health staff in taking weight and length measurements if they have already been doing these in their jobs. Problems in quality control may arise if their techniques are not up to the quality described in the previous section. The only way to overcome this problem is to have a very strict and intensive training program that corrects any bad habits that they may have developed before.

The number of supervisors is also very important. A general rule is that to ensure good quality control of the field work, about one supervisor is needed for every three to four teams of enumerators.

QUESTIONNAIRE

Before the survey can be launched, the questionnaire needs to be designed to collect the information required. The content of the questionnaire is not covered in this paper because this is highly survey specific; however, some basic tips regarding questionnaire format and layout can be given. For example, it is highly recommended that the questionnaires have precoded answers for each question since this will save a great deal of time when it comes to data entry. It is also wise to avoid "open-ended" questions, which can be extremely difficult to categorize at a later date as it involves laborious hand coding when entering the data into the computer. An example of a concise and well-designed questionnaire with precoded answers, which was used in Kenya's national nutrition survey, is shown in Figure 7.

Figure 8 shows an example of a "bare minimum" data collection form for a child nutrition survey, which includes a simple layout for recording data on each child's sex, age, weight, and length, as well as basic identification numbers for the village, family, and child. Identification information is very important as it helps to identify which children belong to which families in different villages. Also if data are collected on mothers, it is important that the identification system allows mothers and their children to be linked for data analysis. This is particularly important in polygamous households or extended family situations. The basic format shown in Figure 8 can easily be adapted to any nutrition survey. The use of boxes is also recommended. The boxes should be large enough to legibly record age, weight, and length.

The questionnaire may need to be revised after the pretest and pilot exercises (described below) if some of the questions pose problems. Arrangements will then need to be made for producing sufficient copies of the questionnaire well in advance of the field survey. It is usually prudent to produce more copies than needed so that the risk of running out of questionnaires during the field survey is avoided. Depending on the number of questionnaires required, photocopying, offset printing, or stencils could be used. If there are many

Figure 7 — Kenya: National Child Nutrition Survey (Rural), 1982

CONFIDENTIAL

MINISTRY OF ECONOMIC PLANNING AND DEVELOPMENT
CENTRAL BUREAU OF STATISTICS: KENYA GOVERNMENT
NATIONAL CHILD NUTRITION SURVEY (RURAL) 1982

TARGET POPULATION: All Children Aged 3 - 60 Months

NUT 3/R1

DATE OF VISIT......................

PROVINCE..........................
DISTRICT..........................
SUB-LOCATION......................
SUPERVISOR........................
ENUMERATOR........................

CL: NO.			HH NO.					CARD TYPE		AMEND NO.	NO. OF CHILDREN		MOTHER SEQUENCE
1	2	3	4	5	6	7	8	9	10	11	12	13	14

CHILD MEASUREMENTS NUTRITION AND MORBIDITY

NAME	SERIAL NUMBER	BIRTH ORDER	SEX 1=M 2=F	DATE OF BIRTH: DAY	DATE OF BIRTH: MONTH	DATE OF BIRTH: YEAR	AGE IN MONTHS	Weight kg	Length cm	MONTHS OF BREAST FEEDING	ANY OTHERMILK	AGE SUPPLEMENT GIVEN (IN MONTHS)	TYPE OF SUPPLEMENT	EVER USED INFANT FORMULA 1=YES 2=NO	AGE WHEN INFANT FORMULA INTRODUCED	IS IT STILL IN USE 1=YES 2=NO	WHICH IS MORE BR OR IN 1=BR 2=IN	OUT OF WHAT IS PORRIDGE MADE	WHAT IS ADDED	WAS CHILD SICK IN LAST 2 WKS	TYPE OF SICKNESS	ACTION TAKEN	WAS FOOD WITHDRAWN 1=YES 2=NO	REMARKS ON CHILDS BUILD 1-V.Thin 2-Thin 3-Normal 4-Fat 5-V.Fat	FOR OFFICE USE
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	18	17	18	19	20	21	22	23	24	25
	15 16	17 18	19	20 21	22 23	24 25	26 27	28 29 30	31 32 33 34	35 36	37	38 39	40	41	42 43	44	45	46	47	48	49	50	51		52 53 54 55 56 57
	15 16	17 18	19	20 21	22 23	24 25	26 27	28 29 30	31 32 33 34	35 36	37	38 39	40	41	42 43	44	45	46	47	48	49	50	51		52 53 54 55 56 57
	15 16	17 18	19	20 21	22 23	24 25	26 27	28 29 30	31 32 33 34	35 36	37	38 39	40	41	42 43	44	45	46	47	48	49	50	51		52 53 54 55 56 57
	15 16	17 18	19	20 21	22 23	24 25	26 27	28 29 30	31 32 33 34	35 36	37	38 39	40	41	42 43	44	45	46	47	48	49	50	51		52 53 54 55 56 57
	15 16	17 18	19	20 21	22 23	24 25	26 27	28 29 30	31 32 33 34	35 36	37	38 39	40	41	42 43	44	45	46	47	48	49	50	51		52 53 54 55 56 57

CODES

OTHER MILKS (Col. 11)
1- Cow Milk
2- Goat Milk
3- Other Livestock Milk (specify)
4- Whole Milk (Powder)
9- Not applicable

TYPE OF SUPPLEMENT (Col. 13)
1- Milk other than Breast
2- Porridge
3- Other (specify)
9- Not applicable.

INGREDIENTS FOR PORRIDGE (Col. 18)
1- Maize only
2- Millet only
3- Cassava only
4- Bananas only
5- Potatoes
6- Maize and Millet
7- Maize, Millet and Cassava
8- Millet and Cassava
9- Other (specify)
0- Not applicable

ADDITIVES (Col. 19)
0- Nothing
1- Milk only
2- Sugar only
3- Milk and Sugar
4- Other (specify)
9- Not applicable

TYPE OF SICKNESS (Col. 21)
1- Fever
2- Diarrhea
3- Fever + Diarrhea
4- Measles
5- Vomitting
6- Fever + Vomitting
7- Diarrhea.+ Vomitting
9- Not applicable

DURATION OF SICKNESS (Col. 20)
0- Not Sick
1- Sick for 1 day
2- Sick for 2-3 days
3- Sick for 4-7 days
4- Sick for over one week

ACTION TAKEN (Col. 22)
1- Taken to H/Centre or Dispensary
2- Taken to Hospital
3- Taken to Private Doctor
4- Purchased Tablets
5- Used Trad. Medicine
6- No. Treatment
9- Not applicable

Source: Republic of Kenya (1983).

Figure 8 – Minimum Format for Questionnaire to Collect Data on Child Nutritional Status

Village ID Number: ☐☐

Date of Interview: ☐☐☐☐☐☐
(dd/mm/yy)

Family ID	Child's ID	Sex 1=m 2=f	Birthdate dd/mm/yy	Weight 1 kg	Weight 2 kg	Length 1 cm	Length 2 cm

different questionnaire modules for each household, it is useful to clip or tie them together to prevent questionnaires from getting out of order and misplaced. Color coding different modules of the questionnaire also helps to keep the survey papers in order. It is also prudent to have on every page of the questionnaire a place to record each household's identification number, usually in an upper corner, in case the papers become separated.

THE PRETEST EXERCISE

Before any field survey is launched, the questionnaire and protocol procedures need to be *pretested* by the organizers of the survey in a field situation to eliminate any ambiguities in the way certain questions are posed or in the way the data are supposed to be collected. It is surprising how the most obvious question may indeed not be as obvious to the respondent and instead may cause a great degree of confusion. These types of problems can only be identified during pretest exercises. It is better to discover these problems well before the supervisors and enumerators are trained so that corrections and amendments to the questionnaire and protocol can be made if necessary.

TRAINING

The quality of the training of the enumerators and supervisors cannot be emphasized enough because of its paramount importance in ensuring that accurate measurements are taken and that the questionnaires are completed at a high level of accuracy. It is essential to schedule adequate time for training the supervisors and enumerators in the techniques of measuring children, as well as in administering other aspects of the questionnaire. The supervisors should be trained first so that they can assist in the training of the field enumerators. Before the beginning of the training session, each enumerator and supervisor should be supplied with a field manual prepared by the survey organizers that contains the following:

(1) concepts of nutritional status
(2) purpose of survey
(3) procedures for measuring children (use Figures 2, 3, 5, and 6 above)
(4) guidelines for administering the questionnaire.

At least half a day is needed to introduce the concept of a nutrition survey, including the basics of anthropometry. Following this, the supervisors and enumerators should spend about two days practicing measuring as many children as possible. This can take place at a preschool where a large number of children are available. Another entire day will be needed (depending on the length of the questionnaire) for training the enumerators and supervisors on how to phrase questions, code answers, and enter the data. After these initial four days, both enumerators and supervisors should spend one or two days undertaking a pilot exercise, which is discussed below, to simulate the actual survey in the field.

During the training exercise, it is also useful to determine the accuracy and precision of the enumerators' weight and height measurements. This can be done by having the enumerators take repeat measurements on a sample of 10 or so children. These values can be statistically compared to the values obtained from a senior and experienced supervisor who is considered to be the most accurate and precise measurer. By comparing the differences in the values obtained by the enumerators and the senior supervisor, the enumerators who are having difficulties in taking measurements can be identified along with the type of problem, whether it is just carelessness or a consistent under- or over-reading. These enumerators should receive extra training until their accuracy and precision are within an acceptable range. A common *standardization protocol* is given in Appendix B.

THE PILOT EXERCISE

A *pilot exercise* should be conducted immediately after the training session. The pilot exercise provides the opportunity for the enumerators and supervisors to practice the final version of the questionnaire before the survey is launched, and it may help to identify problems with the questionnaire that previously went undetected. It does not need to be a big and complicated affair; one or two days of field work in areas that will not be covered later by the field survey should be sufficient. Useful information, such as the average length of time to conduct the interviews, can be gleaned from the pilot exercise. This type of information could be used in finalizing the field work schedule, especially in determining the number of daily interviews that can be conducted by the enumeration team.

OTHER ARRANGEMENTS

The proper types and numbers of vehicles also need to be arranged. If the survey is to take place in rugged rural areas, then four-wheel drive vehicles are necessary, preferably with a long wheel base if the distances are far. Each supervisor should have full-time access to a car, truck, or motorcycle to ensure adequate field visits and supervision. Enumerators can also be provided with motorcycles or bicycles to help them cover long distances. Public transport may be available and, so, a transport allowance needs to be advanced to the field staff to cover these costs. Field staff are often able to make their own arrangements for accommodation in local guest houses or hotels. In more remote areas the organizers of the survey may need to contact local health facilities to arrange accommodation, or alternatively, tents and camping equipment can be supplied for travel to very remote areas.

Another important aspect of conducting a field survey is that in most countries, official clearance from the appropriate authorities is necessary before embarking on data collection. It is not wise to underestimate the importance of completing the necessary government protocol procedures. In addition, it is important that the organizers of the survey also notify the local authorities, whether this be the district commissioner or village headman, that a survey will be conducted in their area. Local authorities need to understand the purpose of the nutrition survey and the results it will produce in order to be able to encourage the residents of their areas to cooperate with the enumerators. Later after the data has been analyzed, it is courteous to give a summary report of the findings to them as this may stimulate their interest in child nutrition issues and help guide their own development and planning activities.

5. DATA COLLECTION AND QUALITY CONTROL

Supervisors should be responsible for maintaining a high degree of quality in the data collected by their enumerators, especially in checking each questionnaire for completeness, accuracy, and neatness. The supervisors should be in field contact with their enumerators at least every two or three days or preferably more. Of course, it is easier to supervise a smaller cross-sectional survey than a large longitudinal survey, which would require a carefully designed supervisory and quality control schedule.

Supervisors should check the accuracy of the equipment during every field visit to their enumerators in order to ensure that the scales and length boards are in good working order. Standard reference weights of 5 and 10 kilograms can be used to check the accuracy of the scales, especially at the higher ranges above 15 kilograms.

In addition, it is also suggested that when supervisors make their field visits to the enumerators, they should also take measurements on a small number of children. This information is useful in determining the accuracy of the anthropometric measurements for each enumerator.

As will be discussed below in the section on data processing, unusually high or low values for weight and height need to be double-checked by the field supervisor, preferably through a visit to the household with the enumeration team, in order to remeasure the child in question. This is one reason why it is important that the supervisors are well acquainted with the data their enumerators are collecting. It is much easier to rectify a mistake when the questionnaire is still in the field office, rather than after it has been forwarded to the central survey office for data processing.

Quality control cannot be overemphasized. One effect of maintaining stringent quality control measures is that it instills a careful attitude on the part of the enumerators (Martorell 1982). If the enumerators realize that each and every questionnaire will be carefully checked by the supervisors, they will probably take more pride in ensuring that their data are collected accurately and recorded legibly.

6. DATA PROCESSING AND ANALYSIS

ORGANIZATION OF DATA PROCESSING

Once the enumerators have completed the questionnaires and turned them over to the supervisors, the supervisors should check every one for completeness and accuracy and ensure that all answers have been entered correctly and unambiguously. The supervisors should keep a complete list of which forms have been completed and turned in by the enumerators so that the submission of forms for data processing can proceed in an orderly and organized fashion. Even after all the forms have been processed, it is important to keep the original questionnaires in a safe place for later reference, if necessary, to verify suspect data.

THE INTERNATIONAL CHILD GROWTH REFERENCE STANDARDS

An important first step in data processing, which is necessary before any data analysis can be undertaken, is converting the raw weight and length measurements to the three indicators of weight-for-height, height-for-age, and weight-for-age. This involves a comparison to a set of published tables containing the international NCHS/WHO child growth reference standards, which are based on a population of well-nourished North American children.[1] The NCHS/WHO reference tables contain data on the distribution of weight and height values, including the median and a selected range of standard deviations, by different sex and age groups of the reference population.[2] The relevant parts of these tables have been reproduced in Appendix 3 for both boys and girls from birth to 59 months. A more complete set of reference tables on children and youth up to the age of 18 years may be found in WHO (1983).

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1 NCHS stands for National Center for Health Statistics.

2 In the NCHS/WHO reference population, the distribution of height-for-age is approximately normal (Gaussian), whereas the distribution of weight-for-height and weight-for-age is somewhat skewed toward higher values because of obese children in the reference population. Therefore, in constructing the NCHS/WHO reference tables for weight-for-height and weight-for-age, the population was divided at the median into two halves and standard deviations calculated separately for the lower and upper halves. This was done by fitting empirical centiles of each half distribution with half a Gaussian curve. Since height-for-age is normally distributed, standard deviations were calculated in the normal fashion (Waterlow et al. 1977).

Even though the NCHS/WHO reference standards are based on a well-nourished population of North American children, their relevance for the assessment of the nutritional status of children in developing countries has been shown. Research studies conducted in developing countries have shown that up to about the age of 10 years, well-nourished and healthy children from different ethnic groups[3] display similar weight and height growth patterns as the NCHS/WHO reference population (Habicht et al. 1974; Alnwick 1980; Stephenson et al. 1983; Martorell and Habicht 1986). However, in these studies children from the same ethnic group but in a lower socioeconomic class show significant deficits in attained height, reflecting nutritional stunting, as compared to the NCHS/WHO reference population.

Nutritional stunting is highly prevalent in children of poorer families and is the cumulative result of socioeconomic and environmental determinants, not ethnic factors. The environment within which poor children live is characterized by too little food in combination with high rates of disease. These two factors are the main determinants of child nutritional status. Therefore, based on current scientific evidence, comparison of the NCHS/WHO reference population standards is accepted to be the most valid method of assessing the levels of growth retardation in young children from developing countries. Even though ethnic differences are minor prior to puberty, it is at this stage that major differentiation between ethnic groups takes place and as a result WHO (1983) recommends against using NCHS/WHO standards to evaluate nutritional status of children older than ten years (Martorell and Habicht 1986).

It should also be noted that the NCHS/WHO reference population is comprised of two groups of well-nourished North American children. The first group of children, 0 to 36 months of age, comes from the Fels Research Institute in Ohio, and the second group of children, from 2 years onward, comes from national samples surveyed by the NCHS. In addition, recumbent body length was used for the younger children in the Fels sample, whereas standing height was used for the children in the NCHS sample. In order to simplify the use of the NCHS/WHO tables, it is recommended that the Fels growth values be used for children 0 to 23 months of age, inclusive, and the NCHS growth values be used for children 24 to 59 months of age, inclusive (see Appendix C).

CONVERTING LENGTH TO HEIGHT

The measurement of a child's recumbent length is greater than the measurement of the standing height because of the effects of gravity. Since length rather than height has been recommended here as the preferred measurement in field surveys, a correction factor needs to be applied during the data processing stage to convert the length measurements of children 24 to 59 months into height values in order to compare them to the NCHS/WHO reference standards

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[3] Far Eastern children (for example, from Japan, China, and Korea) may be an exception; however, even the difference between their growth pattern and the NCHS/WHO reference population is still not large (Martorell and Habicht 1986).

for height. The rule of thumb is that 1.5 centimeters should be subtracted from the length measurements of children 24 to 59 months to approximate standing height (Dibley et al. 1987). For the sake of simplicity, the terms length and height are used interchangeably in the discussion below.

CALCULATING INDICATORS OF NUTRITIONAL STATUS

Two methods are commonly used in developing countries to relate the measurements of weight and height to the NCHS/WHO reference population. The first is known as the *percentage of median method* and the second as the *Z-score method*. The Z-score method is the approach preferred by international child growth experts for statistical reasons, which are explained below.

Percentage of Median

In the percentage of median method, the weight or height value of a child is expressed as a percentage of the median weight or height value in the NCHS/WHO reference population for a child of the same age and sex. For example, if a 42-month-old boy is found to have a weight measurement of 14.2 kilograms, this would be expressed as a percentage of the median weight value of 15.7 kilograms, which is given for boys the same age in the NCHS/WHO reference population. Thus, the percentage of median weight-for-age value for this 42-month-old boy would be calculated as follows:

(14.2 kilograms/15.7 kilograms) * 100 = 90 percent.

In other words, this child has a weight-for-age value of 90 percent of the median weight value for the NCHS/WHO reference boy of the same age. The calculation of height-for-age as a percentage of median is similar. With regard to the calculation of weight-for-height, the weight value of a child would be compared to the median weight value of a reference child of the same height.

The percentage of median method has serious limitations, however, which are related to problems associated with the nutritional interpretation of percentage of median values at different ages, as well as across the different indicators of weight-for-height, height-for-age, and weight-for-age (Martorell 1982). One problem is that the value of percentage of median does not have a constant meaning over different age groups. For example, 95 percent of the median height-for-age is very different at the age of 12 and 48 months. At 12 months, 95 percent of median height-for-age represents the 8th percentile of the reference population, whereas at 48 months it represents the 12th percentile (Waterlow et al. 1977).

A larger problem is that percentage of median values does not have the same nutritional meaning across the three indicators of weight-for-height, height-for-age, and weight-for-age. For example, 90 percent of the median corresponds to the 13th percentile for weight-for-length at 95 centimeters, but to less than 1 percentile for length-for-age at 36 months, which is about the age when girls achieve the median length of 96 centimeters (Martorell 1982). On the other hand, in developing countries the percentage of median approach has been used for many years by health workers for assessing nutritional status. As a result, these professionals appear to be more familiar with it than with the Z-score method, which is discussed below.

Z-Scores

The other method of calculating nutritional indicators involves calculating standard deviation scores, commonly referred to as Z-scores, which relate the relative position of each child's weight and height value to the distribution of the weight and height values of the NCHS/WHO reference population. Experts in child growth highly recommend the use of Z-scores over percentage of the median because Z-scores provide a better statistical assessment of nutritional status, which remains stable over different age groups as well as across the different indicators of weight-for-height, height-for-age, and weight-for-age (Waterlow et al. 1977; Martorell 1982).

The general formula for calculating Z-scores is straightforward and is similar to the concept of a normal cumulative frequency distribution, which is taught in all first year statistics courses. The first step involves calculating the difference between the child's actual weight or height measurement and the median weight or height value in the NCHS/WHO reference population (for the reference child of the same age and sex, and in the case of weight-for-height the same height). The Z-score is then determined by dividing this difference by the *absolute value* of the standard deviation of the NCHS/WHO reference population. However, in the case of weight-for-height and weight-for-age, because the distribution in the NCHS/WHO reference population is skewed, it is important to note that depending on the magnitude of the child's measurement, the standard deviation can be calculated either above or below the median value of the NCHS/WHO reference population. If the child's measurement is less than the median value of the NCHS/WHO reference population, the standard deviation is calculated below the median (Example 1). If a child's measurement is greater than the median value of the NCHS/WHO reference population, the Standard Deviation is calculated above the median (Example 3). In the case of height-for-age (Example 2), since its distribution in the NCHS/WHO reference population is normal, the standard deviation is the same above and below the median.

Example 1 – Calculating WH Z-score:

$$\text{WH Z-score} = \frac{\text{Actual weight of child} - \text{Median weight of reference child (same height, age, sex)}}{\text{Absolute value of standard deviation (S.D.)}}$$

Sample child:

* age: 54 months
* sex: male
* length (measured): 99.0 cm
* height (calculated): 97.5 cm
* reference weight (from table) for child having height of 97.5 cm: 15.1 kg
* calculate absolute value of the standard deviation below the median since boy's weight is below the median weight of reference boy having a height of 97.5:

  e.g. ——> S.D. = 15.1 - 13.8 = |1.3 kg|

Thus:

$$\text{WH Z-score} = \frac{12.3 - 15.1}{1.3}$$

$$\text{WH Z-score} = -2.15$$

Example 2 — Calculating HA Z-score:

$$\text{HA Z-score} = \frac{\text{Actual height of child} - \text{Median height of reference child (same age, sex)}}{\text{Absolute value of standard deviation (S.D.)}}$$

Sample child:

* age: 24 months
* sex: male
* length (measured): 79.1 cm
* height (calculated): 77.6 cm
* reference height (from table): 85.6 cm
* calculate absolute value of the standard deviation below median, it does not matter since NCHS/WHO reference distribution of HA is normal:

  e.g. ——> S.D. = 85.6 - 82.4 = |3.2 cm|

Thus:

$$\text{HA Z-score} = \frac{77.6 - 85.6}{3.2}$$

$$\text{HA Z-score} = -2.50$$

Example 3 — Calculating WA Z-score:

$$\text{WA Z-score} = \frac{\text{Actual weight of child} - \text{Median weight of reference child (same age, sex)}}{\text{Absolute value of standard deviation (S.D.)}}$$

Sample child:

* age: 54 months
* sex: female
* weight: 17.2 kg

* reference weight (from table): 16.8 kg

* calculate absolute value of the standard deviation above the median since girl's weight is greater than median value of reference girl the same age:

  e.g. ——> S.D. = 16.8 - 19.4 = |-2.6 kg|

Thus:

$$\text{WA Z-score} = \frac{17.2 - 16.8}{2.6}$$

$$\text{WA Z-score} = +0.15$$

The normal range of growth is considered to be between plus and minus two Z-scores, which covers close to 95 percent of the NCHS/WHO reference population. As mentioned earlier, the use of Z-scores is highly recommended because of their statistical relevance and because they overcome the troublesome problems associated with the percentage of median approach.

CLASSIFICATION OF NUTRITIONAL STATUS: WASTING, STUNTING, AND UNDERWEIGHT

After the indicators of weight-for-height, height-for-age, and weight-for-age have been calculated, either by the percentage of median approach or by the Z-score approach, certain cutoff criteria are used to classify nutritional status. Classification systems commonly used in developing countries are summarized below:

Percentage of Median (adapted from Griffiths 1985):

Weight-for-height:	above 85 percent	adequate
	85 to 80 percent	moderate malnutrition
	below 80 percent	wasted

Height-for-age:	90 percent or more	adequate
	below 90 percent	stunted
Weight-for-age:	91 to 110 percent	normal
	81 to 90 percent	mild underweight
	61 to 80 percent	moderate underweight
	60 percent or less	severe underweight

Z-Scores (WHO/Brazzaville n.d.):

All three indicators:	above -1.00 S.D.	normal
	-1.00 to -1.99 S.D.	mild malnutrition
	-2.00 to -2.99 S.D.	moderate malnutrition
	-3.00 S.D. and below	severe malnutrition

RAPID FIELD CALCULATIONS

Very often preliminary results of a survey are needed immediately, and the computer analysis may take too long. If the results are needed urgently, then certain shortcut methods can be used to allow the calculation of the malnutrition prevalence figures while the field survey is still ongoing.

The supervisors can easily do this by making lists of each child's sex, age, weight, and height data, which they can compile regularly as they routinely check the accuracy and completeness of each of their enumerator's questionnaires. An example of a format for this type of data list is shown below in Figure 9. The weight and length values entered for each child on the list can then be compared to lookup tables, such as the ones shown in Appendix D. By comparing each child's measurements to the values for the reference population in the lookup tables, a quick tally can be done on the numbers of children falling below the different Z-score cutoff levels. The lookup tables given in Appendix D could be simplified further by only having the column for the Z-score cutoff of below -2.00. If this quick tally method is followed during the field work, by the time the survey is complete it will be possible to have preliminary malnutrition figures by hand calculating the numbers of children falling into each Z-score cutoff category as a proportion of all the children included in the survey.

COMPUTER SOFTWARE PROGRAMS

Certain computer software programs have been developed for processing, cleaning, analyzing, and tabulating child anthropometric data. These software programs convert the raw height, weight, sex, and age data into the nutritional indicators of weight-for-height, height-for-age, and weight-for-age. One popular package that can be used on most IBM compatible computers is the CASP program developed by CDC in Atlanta, Georgia (CASP version 3.2; see address for CDC in Appendix A). This program will automatically produce either percentage of median

Figure 9 — Example of a Data Collection Form for Quick Tally of Child Nutritional Status While Survey is Still in the Field

Village Name:

Date:

						Tick the appropriate boxes to classify child's HA and WH Z-scores:					
						Height-for-age Z-score:			Weight-for-Height Z-score:		
Family ID Number	Child ID Number	Sex of Child	Age (months)	Weight (kg)	Length * (cm)	above -2.00	-2.00 to -2.99 moderate stunting	-3.00 or below severe stunting	above -2.00	-2.00 to -2.99 moderate wasting	-3.00 or below severe wasting
					Number of Children						
					Percent of Total						

* Note: For children 24 months and older 1.5 cm needs to be subtracted from their length value to approximate height so that the NCHS/WHO reference tables can be used.

or Z-scores as well as tabulate the data according to the guidelines recommended by international experts (Waterlow et al. 1977). A more recent computer program, EPI-INFO, is now available and contains an anthropometric module based on the CASP program. It is intended to eventually replace CASP. It can be obtained from either CDC or the Nutrition Unit in WHO/Geneva and includes many other epidemiological functions.

Alternatively, a computer programmer could use the values shown in the NCHS/WHO tables (Appendix C) and devise a simple program to calculate the indicators of nutritional status according to the examples given above. In addition, the conversion of length to height for children 24 months and above could also be programmed into the computer.

SUSPECT VALUES

One of the first steps in cleaning survey data involves scanning the data for outliers that are suspiciously low or high. Both the raw weight and height data, as well as the calculated indicators of nutritional status, can be examined using simple scatterplots. In this way extreme outliers can be flagged. Any suspect values should be noted and the data forms checked. If this fails to clarify the problem, the supervisor and enumerator should, if possible, revisit the household in order to remeasure the child in question. Unfortunately, these types of suspect values are often detected too late to return to the field to remeasure children. Under these circumstances, the obviously incorrect values should be deleted from the data files. If many measurements are suspect, it is prudent to mark the suspect cases and further investigate any common characteristics, such as to which enumerator they belong or from which village they came. Sometimes consistent errors in the recording of data by the enumerators can be uncovered this way.

7. DATA PRESENTATION

DESCRIBING THE SAMPLE

It is very important that the information collected in the field survey is ultimately presented clearly and concisely and is of benefit to the potential users of the data. Reports from nutrition surveys often suffer from poorly presented data, which make it impossible for the reader to decipher the results.

Some basic rules should always be followed when presenting the results of a child nutrition survey. First, the sample needs to be described with enough accuracy in regard to its representativeness, composition, and numbers of children. It is useful to begin the report with a general table that breaks down the sample by the numbers of boys and girls in each age group. Table 1 provides an example of a standard layout for such a summary table.

AGE CATEGORIES

When presenting anthropometric data, experts recommend (Waterlow et al. 1977) that the following age categories be used if there are at least 100 children in each age group:

0 thru < 2 months
3 thru < 5 months
6 thru < 6 months
9 thru < 11 months
12 thru < 23 months
24 thru < 35 months
36 thru < 47 months
48 thru < 59 months

If there are fewer than 100 children in each of the above age groups, then the following collapsed age categories are recommended:

0 thru < 5 months
6 thru < 11 months
12 thru < 23 months
24 thru < 35 months
36 thru < 47 months
48 thru < 59 months

Table 1 — Composition of the Sample of Children Surveyed in Kenya's National Nutrition Survey, 1978/79

Location/ Province	No. of Children	Percent		Percent by Age (Months)				
		Male	Female	6-11	12-23	24-35	36-47	48-59
Rural								
Coast	300	50	50	8	23	22	22	22
Eastern	252	53	47	8	20	23	21	23
Central	736	52	48	11	22	25	22	23
Rift Valley	371	49	51	10	24	21	22	25
Nyanza	730	51	49	10	23	21	21	24
Western	270	49	51	8	27	23	21	22
Urban								
Nairobi	306	55	45	8	25	22	23	23
Coast	222	55	45	11	21	23	21	25
Other	338	53	47	11	19	22	22	25
Kenya	**3,525**	**52**	**48**	**10**	**23**	**23**	**21**	**24**

Source: Republic of Kenya (1979).

PRESENTING DATA ON NUTRITIONAL STATUS

It is also recommended that the primary indicators of interest should be weight-for-height and height-for-age to give a clear assessment of the problems of nutritional wasting and stunting. Weight-for-age is useful because it provides a mixed indicator of both nutritional wasting and stunting; but it is not always easy to interpret the meaning of the weight-for-age data in terms of the nature of the malnutrition problem.

The use of Z-scores is highly recommended for presenting the results of an anthropometric survey to eliminate the problems associated with the percentage of median approach. However, some researchers, particularly health personnel, still prefer the percent of median approach. To avoid confusion, a good rule of thumb is to present the results as Z-scores in the main text of the report and, if desired, include percentage of median results as an appendix.

It is also recommended that for each sex and age group in the sample, the distribution of the nutritional status indicators be presented as mean and standard deviations. It is also useful to present the prevalence of nutritional wasting, stunting, and underweight by giving the percentage of children, by age and sex, who have nutritional indicators that fall below the different cutoff criteria shown above (WHO 1986). In summary, the suggested tables for presenting the malnutrition figures should include the following (broken down by sex and age and giving sample sizes):

(1) mean values and standard deviations of nutritional indicators
(2) percentage of children with indicators below different cutoff levels (i.e., with Z-scores $\leq$ -2.00 and $\leq$ -3.00).

An example of presenting the levels of malnutrition is shown in Table 2. It is important to keep the format of a table simple and not overcrowded with numbers. The symbol "N" is commonly used in the presentation of data to denote the sample size. For presenting data on Z-scores, as shown in Table 2, rounding off to the nearest hundredth is acceptable — for example, a Z-score equivalent to -1.25. For presenting data on the percentage of the median method, rounding off to the nearest tenth is sufficient — for example, 87.5 percent.

Some researchers also put the more detailed data related to the raw measurements at the end of the main body of the report as an appendix. This is especially useful for presenting the distribution statistics (i.e., means and standard deviations) of the raw weight and height data by age and sex.

It is also very useful to look at deficits in weight-for-height (wasting) in relation to deficits in height-for-age (stunting) with Z-scores (Waterlow et al. 1977). In this way the percentage of children who are normal, wasted, stunted, or wasted and stunted can be determined. A format for such a table is shown in Table 3. The categories of Z-scores could be expanded below -2.00 by units of 0.50 or 1.00, if desired; however, the classification points at -3.00 and -4.00 should be maintained. Table 4 presents this same type of data in a simplified format.

Table 2 — Kenya: Example of a Summary Presentation of the Results of a Nutrition Survey

	Percent Malnourished		Z-Score	
	≤-2	**≤-3**	**Mean**	**(S.D.)**
Stunted				
Northern Region	32.8	15.8	-1.61	(1.84)
Central Region	39.1	19.2	-1.82	(1.77)
Southern Region	27.5	11.0	-1.42	(1.62)
Wasted				
Northern Region	4.2	2.1	-0.19	(1.31)
Central Region	4.0	1.5	-0.33	(1.27)
Southern Region	3.3	1.1	0.16	(1.24)
Underweight				
Northern Region	29.8	10.2	-1.21	(1.29)
Central Region	32.8	12.6	-1.45	(1.34)
Southern Region	25.1	6.1	-0.93	(1.41)

Table 3 — Weight-for-Height and Height-for-Age

Weight-for-height Z-score:	Height-for-Age Z-Score: More Than -2.00	Height-for-Age Z-Score: -2.00 or Less
More than -2.00	% Normal	% Stunted
-2.00 or less	% Wasted	% Stunted and Wasted

Table 4 — Example of Simplified Cross-Classification of Weight-for-Height and Height-for-Age, by Sex

	Boys	Girls
	Percent	
Normal	59.4	61.9
Stunted only	34.6	33.7
Wasted only	3.9	3.5
Wasted and stunted	2.1	0.9

Source: Republic of Kenya (1979).

DATA ANALYSIS WITH INDICATORS OF NUTRITIONAL STATUS

The indicators of nutritional status can be statistically tested to examine relationships between nutritional status and other variables, as well as differences between different groups of children. Because of their derivation, Z-scores are particularly useful for statistical testing. For example, the percentage of children falling into the different categories of nutritional status can be compared across different groups of children using distributional tests (i.e., chi-square). In addition, mean Z-score values can be calculated for different groups of children at the household or community level to allow statistical comparisons with nutritional status. Z-scores can also be treated as a continuous variable that can be analyzed with other nonnutritional variables such as socioeconomic indicators (Martorell 1982).

8. REPORT PREPARATION

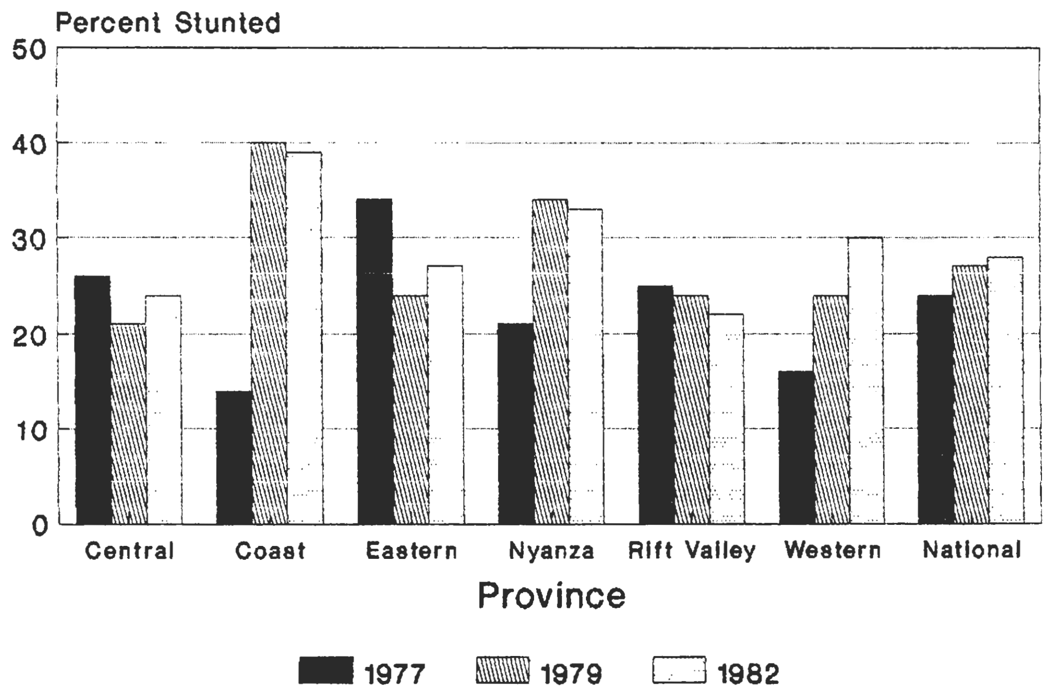
Once the field work has been completed and the data analyzed and tabulated along the lines of the examples given above, it is important that this valuable information is written up as succinctly and clearly as possible. The degree of technicality of the report will depend on its intended audience. The language of the report needs to match the background of the intended reader. Busy policymakers will not be able to grasp the intricacies of how Z-scores are calculated, but they need to know the levels of nutritional wasting and stunting in the different socioeconomic groups in the population or in different areas of the country.

A brief 3- or 4-page report would no doubt have a greater impact on policymakers than a bulky 30-page volume. The report should be organized along the following lines:

(1) Executive summary giving the main findings (no more than 1 page);
(2) Introduction, including a brief description of the survey (put details of sampling and methodology as an appendix);
(3) Main findings;
(4) Discussion and conclusion;
(5) Technical appendices.

The presentation of the data requires careful thought. The impact of a few well-designed tables is much greater than that of long series of poorly designed tables. In some instances, the use of graphics has an even greater effect in conveying the meaning of the data than do tables. Figure 10 shows the results of the second national nutrition survey in Kenya, and at a glance it is obvious which regions are nutritionally worse off.

Figure 10 — Child Nutrition in Kenya: Trends from 1977 to 1982, by Province



Source: Republic of Kenya (1983).

APPENDIX A

USEFUL ADDRESSES FOR ORDERING EQUIPMENT TO MEASURE CHILDREN
(Alnwick 1985; Griffiths 1985)

Child Weighing Scales (hanging type of 25 kilograms by 100 grams):

UNIPAC
UNICEF Procurement and Assembly Centre
UNICEF Plad, Freeport - 2100
Copenhagan 0, Denmark
Telex 19813
Telephone 01-26-24-44

ITAC Corporation
P.O. Box 1742
Silver Spring, Maryland 20902 U.S.A.

C.M.S. Weighing Equipment, Ltd.
18 Camden High Street
London, NW1 OJH, United Kingdom

Salter Industrial Measurement, Ltd.
George Street
West Bromwich, B70 6AD, United Kingdom

Program for Appropriate Technology for Health (PATH)
Canal Place
130 Nickerson Street
Seattle, Washington 98109, U.S.A.
Telex 4740019
Telephone 206-285-3500

Appropriate Health Resources and Technologies Action Group (AHRTAG)
85 Marylebone High Street
London W1M 3DE, United Kingdom

Child Boards:

UNIPAC
UNICEF Procurement and Assembly Centre
UNICEF Plad, Freeport - 2100
Copenhagan 0, Denmark
Telex 19813
Telephone 01-26-24-44

Instructions for Constructing Locally Made Length Boards are Available from:

Appropriate Health Resources and Technologies Action Group (AHRTAG)
85 Marylebone High Street
London W1M 3DE, United Kingdom

Centers for Disease Control
Department of Health and Human Service
Atlanta, Georgia 30333, U.S.A.

World Health Organization
Nutrition Unit
Geneva, Switzerland

Shorr Measuring Board Construction Kit
(includes everything but wood)
International Science and Technology Institute
2033 M St. N.W.
Suite 300
Washington, D.C., U.S.A.

Other Useful Addresses for Information on Child Nutritional Assessment Include:

American Public Health Association
International Health Program
1015 Fifteenth Street, N.W.
Washington, D.C. 20005, U.S.A.

OXFAM
Medical Unit
Banbury Road
Oxford, United Kingdom

Save the Children Fund
17 Grove Land
London SE5 8RD, United Kingdom

TALC - Teaching Aids at Low Cost
P.O. Box 49, St. Albans
Herts. AL1 4AX, United Kingdom
Telex 266020 CORALP G
Telephone 0727-53869

APPENDIX B

STANDARDIZATION PROTOCOL FOR TRAINING ENUMERATORS TO TAKE MEASUREMENTS
(UNSO/NHSCP 1986; Habicht 1974; and WHO 1983)

Standardization is the process of teaching the survey team how to take measurements by checking the precision and accuracy of each enumerator. Precision is defined here as the ability to repeat a measurement of the same subject with a minimum variation. Accuracy is defined here as the ability to obtain a measurement that will duplicate as closely as possible the "true" value. The "true" value can be considered either the average of the measurements made by all the enumerators or the measurement made by the trainer/supervisor. The test for accuracy is the more important of the two, so the basis for enumerator selection and evaluation may be the accuracy test alone.

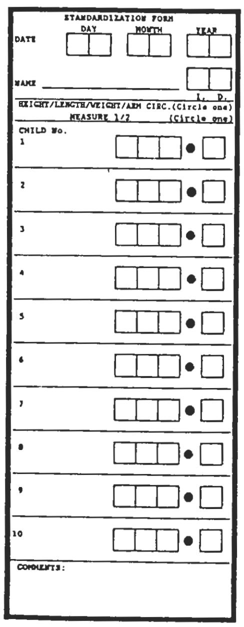
METHOD A: USING THE SUPERVISOR AS THE STANDARD[4]

1. Data Collection

Ten subjects are usually required for standardization procedures. Each enumerator measures each subject twice, but the enumerator should not be allowed to see the first measurement when taking the second. The results of the initial measurements *of all children* are noted on an appropriate record form and put aside until the second set of measurements of the same children is taken. A suitable record form would be as follows:

Illustration 126

Sample Standardization Test Form


STANDARDIZATION FORM
DATE DAY MONTH YEAR
NAME
I. D.
HEIGHT/LENGTH/WEIGHT/ARM CIRC. (Circle one)
MEASURE 1/2 (Circle one)
CHILD No.
1
2
3
4
5
6
7
8
9
10
COMMENTS:

---

4 Adapted from WHO (1983).

The result of this standardization procedure, using the heights of children as an illustration, is shown in Appendix Table B.1. (In practice, half of the children measured should be younger than two years and half older than two years of age.)

Appendix Table B.1 — Raw Data in a Standardization Test for Measurements of Height of Children (in millimeters)

Child No.	Trainer/ Supervisor		Enumerators U		V		W		X		Y		Z	
	a	b	a	b	a	b	a	b	a	b	a	b	a	b
1	828	822	819	826	841	834	833	828	838	825	842	837	836	819
2	838	846	846	846	842	854	849	856	850	856	861	854	860	845
3	860	856	863	861	856	865	875	853	882	872	862	858	873	860
4	862	860	862	850	866	855	854	864	856	869	875	865	874	854
5	820	820	825	823	827	826	826	822	836	828	826	827	818	827
6	856	854	857	862	855	860	856	864	862	873	864	860	858	856
7	823	824	824	825	826	824	827	826	832	825	820	835	818	827
8	876	876	880	875	877	875	873	878	879	887	884	882	876	874
9	801	806	810	804	811	810	809	808	811	800	820	815	800	797
10	853	865	858	852	859	860	857	860	856	856	866	870	852	856

Column a = first measurement.
Column b = second measurement, independently made and recorded.
□ = examples of inadequate measurements in terms of precision.

2. Step-by-Step Calculations

Appendix Table B.2 — Calculations of a Standardization Test Using the Data of Enumerator Y in Appendix Table B.1

Child No.	Step 1 1st(a) measurement (1)	Step 1 2nd(b) measurement (2)	Step 2 PRECISION cols. 1 – 2 (3)	Step 2 PRECISION cols. $(1-2)^2$ (4)	Step 3 Enumerator's (a + b) (5)	Step 4 Trainer/ Supervisor's (a + b) (6)	Step 5 ACCURACY cols. 5 – 6 (7)	Step 5 ACCURACY cols. $(5-6)^2$ (8)
1	842	837	+5	25	1679	1650	+29	841
2	861	854	+7	49	1715	1684	+31	961
3	862	858	+4	16	1720	1716	+4	16
4	875	865	+10	100	1740	1722	+18	324
5	826	827	–1	1	1653	1640	+13	169
6	864	860	+4	16	1724	1710	+14	196
7	820	835	–15	225	1655	1647	+8	64
8	884	882	+2	4	1766	1752	+14	196
9	820	815	+5	25	1635	1607	+28	784
10	866	870	–4	16	1736	1718	+18	324
Totals				477				3875

As shown in Appendix Table B.2, the following calculations are carried out:

Step 1 – The two measurements are entered in the first two columns.
Step 2 – The second measurement is subtracted from the first measurement, and the result, i.e., *precision*, is entered in the third column with its appropriate sign, and then the square of that figure is entered in the fourth column.
Step 3 – The sum of the enumerator's two measurements of each child is entered in the fifth column.
Step 4 – The sum of the trainer/supervisor's two measurements of each child is entered in the sixth column.
Step 5 – The sum of the trainer/supervisor's measurements (column 6) is subtracted from the sum of the enumerator's measurement (column 5) and the result, i.e., *accuracy*, is entered in the seventh column with its appropriate sign, and then squared in the eighth column.
Step 6 – Total the figures in column 4 and the figures in column 8 for all children. These totals of column 4 (*precision*) and column 8 (*accuracy*) of each enumerator (i.e., 477 and 3,875 in the case of enumerator Y) are then transferred to a single sheet of paper as in the following Appendix Table B.3.

Appendix Table B.3 – Summary of Findings from the Standardization Tests

Measurers	PRECISION Totals (col. 4)	PRECISION Signs* (col. 3)	ACCURACY Totals (col. 8)	ACCURACY Signs* (col. 7)	Observations (by Supervisor)
Trainer/ Supervisor	294**	4/8	NA	NA	Best precision, as expected
Enumerators U	324	6/9	524	7/10	Both precision and accuracy satisfactory
V	431	6/10	1195	8/9	Precision satisfactory. Accuracy deficient; values too great by 3.8 mm. Re-examine same children under supervision, with instruction.
W	774	5/10	1024	7/10	Poor precision due to one poor repeated measurement; accuracy approaching the adequate. With better precision, accuracy would be expected to be adequate.
X	893	5/9	3655	9/10	Overall poor precision: measures 7.4 mm. too long; poor attitude and carelessness observed. Need to talk to enumerator and restandardize.
Y	477	7/10	3875	10/10	Precision satisfactory; doing something wrong systematically. 8.9 mm. too long. On repeating measurement, enumerator is observed to stretch children while measuring them.
Z	1278	7/10	1040	6/10	Poor precision and accuracy due to faulty first four measures, thereafter satisfactory. Remeasure.

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* The sum of the most frequently occurring sign is the numerator, the total number of signs is the denominator. Zeros are ignored.

** The sum of the squared differences of the two measurements of the trainer/ supervisor shown in the first two measurement columns of Appendix Table B.1, i.e., $(a - b)^2$.

3. Evaluation of Results

In evaluating the results in Appendix Table B.3, the following *general rules* apply:

(a) The trainer/supervisor's precision will usually be the greatest because of expected greater competence and, therefore, the sum of the trainer/supervisor's column 4 will correspondingly be the smallest. Ideally, this should be equal to zero for both the trainer/supervisor and the enumerator. In practice, for adequate precision, it is considered acceptable if the sum of the enumerator's column 4 (magnitude being inversely related to precision) is arbitrarily no more than twice the sum of the trainer/supervisor's column 4, i.e., 588 (294 x 2).

(b) An enumerator's column 8 should ideally be equal to zero. In practice, for adequate accuracy, it is considered acceptable if the enumerator's column 8 (magnitude being inversely related to accuracy) is arbitrarily no more than three times the sum of the trainer/supervisor's column 4, i.e., 882 (294 x 3).

(c) An enumerator's column 8 should be larger than his column 4. If it is not, the result should be closely scrutinized and measurements retaken as is recommended in the case of enumerator Z in Appendix Table B.3.

One weakness of these arbitrary rulings is that they result in different levels of acceptability in an enumerator's measurements, depending on the quality of the measurements of the trainer/supervisor. An enumerator working with a poor trainer/supervisor will be allowed a greater margin of error than an enumerator working with an expert trainer/supervisor. Clearly, if the quality of the trainer/supervisor is not considerably better than that of the average enumerator or there is a wide variation among supervisors, this method of comparison should not be used.

The summary of the results as they are presented in Appendix Table B.3 are then examined, bearing in mind the three rules listed above. When inadequacies are revealed by applying these rules, the next step is to examine the signs of the differences which can show if an enumerator is making a *systematic error* or not. If, with 10 duplicate measurements, 9 out of 10 differences have the *same* sign, there is a very high probability that *a systematic error is being made*. If this type of systematic error is discovered when checking for *precision*, i.e., column 4, then it is probable that the two rounds of measurements were different due to different measuring techniques of the enumerator, who might have been overtired during the second round; to problems with the measuring equipment between rounds as when the scales are not properly zeroed; to an actual difference in the child, when the child eats or goes to the toilet between weighings; or to some other similar systematic problem.

If this type of systematic error is discovered in calculating for *accuracy*, i.e., column 8, then there is a very high probability that the *enumerator has a systematic bias*. In this case the measuring should be observed for such errors as incorrect reading of the scale or stretching of the child while taking length measurements. On the other hand, inaccuracy where less than 9 out of 10 difference signs are the same suggests the need for the enumerator to take greater general care during measuring.

To sum up, a large column 4 total, i.e., poor precision, indicates careless measuring, fatigue, or changes in the subject over a period of time to be determined by an inspection of signs or single differences.

A large column 8 total, i.e., poor accuracy, indicates carelessness, a systematic bias if the signs indicate this, or lapses in performance revealed by large single differences.

Once the nature of the error is identified, correction is usually simple.

APPENDIX C

INTERNATIONAL NCHS/WHO CHILD REFERENCE TABLES
(WHO 1983)

Note: The data given in Tables 1, 3, 5, 7, 9, and 11 are from the tables on the Fels sample of children where recumbent length is the measurement used, while the data given in Tables 2, 4, 6, 8, 10, and 12 are from the NCHS sample of children where standing height is the measurement used (WHO 1983). Therefore, for children 0-23 months of age, recumbent length must be used when using the Reference Tables. For children 24-59 months of age standing height must be used; therefore, an adjustment of 1.5 centimeters must be subtracted from the recumbent length measurement to approximate height (see text for further explanation).

Appendix Table C.1 — Length (centimeters) by Age of Boys Aged 0 to 23 Months

Age (Months)	Standard Deviations		
	-1 S.D.	Median	+1 S.D.
0	48.2	50.5	52.8
1	52.1	54.6	57.0
2	55.5	58.1	60.7
3	58.5	61.1	63.7
4	61.0	63.7	66.4
5	63.2	65.9	68.6
6	65.1	67.8	70.5
7	66.8	69.5	72.2
8	68.3	71.0	73.6
9	69.7	72.3	75.0
10	71.0	73.6	76.3
11	72.2	74.9	77.5
12	73.4	76.1	78.8
13	74.5	77.2	80.0
14	75.6	78.3	81.1
15	76.6	79.4	82.3
16	77.5	80.4	83.4
17	78.5	81.4	84.4
18	79.4	82.4	85.4
19	80.2	83.3	86.4
20	81.1	84.2	87.4
21	81.9	85.1	88.4
22	82.7	86.0	89.3
23	83.5	86.8	90.2

Appendix Table C.2 — Height (centimeters) by Age of Boys Aged 24 to 59 Months

Age (Months)	Standard Deviations		
	-1 S.D.	**Median**	**+1 S.D.**
24	82.4	85.6	88.8
25	83.2	86.4	89.7
26	83.9	87.2	90.6
27	84.7	88.1	91.4
28	85.4	88.9	92.3
29	86.2	89.7	93.1
30	86.9	90.4	94.0
31	87.6	91.2	94.8
32	88.3	92.0	95.6
33	89.0	92.7	96.4
34	89.7	93.5	97.2
35	90.4	94.2	98.0
36	91.1	94.9	98.7
37	91.8	95.6	99.5
38	92.4	96.3	100.2
39	93.1	97.0	101.0
40	93.8	97.7	101.7
41	94.4	98.4	102.4
42	95.0	99.1	103.1
43	95.7	99.7	103.8
44	96.3	100.4	104.5
45	96.9	101.0	105.2
46	97.5	101.7	105.9
47	98.1	102.3	106.6
48	98.7	102.9	107.2
49	99.3	103.6	107.9
50	99.9	104.2	108.5
51	100.4	104.8	109.1
52	101.0	105.4	109.8
53	101.6	106.0	110.4
54	102.1	106.6	111.0
55	102.7	107.1	111.6
56	103.2	107.7	112.8
57	103.7	108.3	112.8
58	104.3	108.8	113.4
59	104.8	109.4	114.0

Appendix Table C.3 — Length (centimeters) by Age of Girls Aged 0 to 23 Months

Age (Months)	Standard Deviations		
	-1 S.D.	Median	+1 S.D.
0	47.7	49.9	52.0
1	51.2	53.5	55.8
2	54.4	56.8	59.2
3	57.1	59.5	62.0
4	59.4	62.0	64.5
5	61.5	64.1	66.7
6	63.3	65.9	68.6
7	64.9	67.6	70.2
8	66.4	69.1	71.8
9	67.7	70.4	73.2
10	69.0	71.8	74.5
11	70.3	73.1	75.9
12	71.5	74.3	77.1
13	72.6	75.5	78.4
14	73.7	76.7	79.6
15	74.8	77.8	80.7
16	75.9	78.9	81.8
17	76.9	79.9	82.9
18	77.9	80.9	84.0
19	78.8	81.9	85.0
20	79.7	82.9	86.0
21	80.6	83.8	87.0
22	81.5	84.7	87.9
23	82.4	85.6	88.9

Appendix Table C.4 — Height (centimeters) by Age of Girls Aged 24 to 59 Months

Age (Months)	Standard Deviations		
	-1 S.D.	**Median**	**+1 S.D.**
24	81.3	84.5	87.7
25	82.1	85.4	88.6
26	82.9	86.2	89.5
27	83.7	87.0	90.4
28	84.5	87.9	91.3
29	85.2	88.7	92.1
30	86.0	89.5	93.0
31	86.7	90.2	93.8
32	87.4	91.0	94.6
33	88.1	91.7	95.4
34	88.8	92.5	96.1
35	89.5	93.2	96.9
36	90.2	93.9	97.6
37	90.9	94.6	98.4
38	91.5	95.3	99.1
39	92.2	96.0	99.8
40	92.8	96.6	100.5
41	93.4	97.3	101.2
42	94.0	97.9	101.8
43	94.7	98.6	102.5
44	95.3	99.2	103.1
45	95.8	99.8	103.8
46	96.4	100.4	104.4
47	97.0	101.0	105.1
48	97.6	101.6	105.7
49	98.1	102.2	106.3
50	98.7	102.8	106.9
51	99.3	103.4	107.5
52	99.8	104.0	108.1
53	100.3	104.5	108.7
54	100.9	105.1	109.3
55	101.4	105.6	109.9
56	101.9	106.2	110.5
57	102.4	106.7	111.1
58	102.9	107.3	111.6
59	103.5	107.8	112.2

Appendix Table C.5 — Weight (kilograms) by Age of Boys Aged 0 to 23 Months

Age (Months)	Standard Deviations		
	-1 S.D.	**Median**	**+1 S.D.**
0	2.9	3.3	3.8
1	3.6	4.3	5.0
2	4.3	5.2	6.0
3	5.0	6.0	6.9
4	5.7	6.7	7.6
5	6.3	7.3	8.2
6	6.9	7.8	8.8
7	7.4	8.3	9.3
8	7.8	8.8	9.8
9	8.2	9.2	10.2
10	8.6	9.5	10.6
11	8.9	9.9	10.9
12	9.1	10.2	11.3
13	9.4	10.4	11.5
14	9.6	10.7	11.8
15	9.8	10.9	12.0
16	10.0	11.1	12.3
17	10.1	11.3	12.5
18	10.3	11.5	13.7
19	10.5	11.7	12.9
20	10.6	11.8	13.1
21	10.8	12.0	13.3
22	10.9	12.2	13.5
23	11.1	12.4	13.7

Appendix Table C.6 — Weight (kilograms) by Age of Boys Aged 24 to 59 Months

Age (Months)	Standard Deviations		
	-1 S.D.	Median	+1 S.D.
24	11.2	12.3	14.0
25	11.4	12.5	14.2
26	11.5	12.7	14.4
27	11.7	12.9	14.6
28	11.8	13.1	14.8
29	12.0	13.3	15.1
30	12.1	13.5	15.3
31	12.3	13.7	15.5
32	12.4	13.9	15.7
33	12.6	14.1	15.9
34	12.7	14.3	16.0
35	12.9	14.4	16.2
36	13.0	14.6	16.4
37	13.2	14.8	16.6
38	13.3	15.0	16.8
39	13.5	15.2	17.0
40	13.6	15.3	17.2
41	13.8	15.5	17.4
42	13.9	15.7	17.6
43	14.1	15.8	17.8
44	14.2	16.0	18.0
45	14.4	16.2	18.2
46	14.5	16.4	18.4
47	14.6	16.5	18.6
48	14.8	16.7	18.7
49	14.9	16.9	18.9
50	15.1	17.0	19.1
51	15.2	17.2	19.3
52	15.4	17.4	19.5
53	15.5	17.5	19.7
54	15.7	17.7	19.9
55	15.8	17.9	20.1
56	16.0	18.0	20.3
57	16.1	18.2	20.5
58	16.3	18.3	20.7
59	16.4	18.5	20.9

Appendix Table C.7 — Weight (kilograms) by Age of Girls Aged 0 to 23 Months

Age (Months)	Standard Deviations		
	-1 S.D.	Median	+1 S.D.
0	2.7	3.2	3.6
1	3.4	4.0	4.5
2	4.0	4.7	5.4
3	4.7	5.4	6.2
4	5.3	6.0	6.9
5	5.8	6.7	7.5
6	6.3	7.2	8.1
7	6.8	7.7	8.7
8	7.2	8.2	9.1
9	7.6	8.6	9.6
10	7.9	8.9	9.9
11	8.2	9.2	10.3
12	8.5	9.5	10.6
13	8.7	9.8	10.8
14	8.9	10.0	11.1
15	9.1	10.2	11.3
16	9.3	10.4	11.5
17	9.5	10.6	11.8
18	9.7	10.8	12.0
19	9.8	11.0	12.2
20	10.0	11.2	12.4
21	10.2	11.4	12.6
22	10.3	11.5	12.8
23	10.5	11.7	13.0

Appendix Table C.8 — Weight (kilograms) by Age of Girls Aged 24 to 59 Months

Age (Months)	Standard Deviations		
	-1 S.D.	Median	+1 S.D.
24	10.6	11.8	13.2
25	10.8	12.0	13.5
26	11.0	12.2	13.7
27	11.2	12.4	14.0
28	11.3	12.6	14.2
29	11.5	12.8	14.5
30	11.7	13.0	14.7
31	11.9	13.2	15.0
32	12.0	13.4	15.2
33	12.2	13.6	15.4
34	12.3	13.8	15.6
35	12.5	13.9	15.8
36	12.6	14.1	16.1
37	12.8	14.3	16.3
38	12.9	14.4	16.5
39	13.1	14.6	16.7
40	13.2	14.8	16.9
41	13.3	14.9	17.0
42	13.5	15.1	17.2
43	13.6	15.2	17.4
44	13.7	15.4	17.6
45	13.9	15.5	17.8
46	14.0	15.7	18.0
47	14.1	15.8	18.1
48	14.3	16.0	18.3
49	14.4	16.1	18.5
50	14.5	16.2	18.7
51	14.6	16.4	18.9
52	14.8	16.5	19.0
53	14.9	16.7	19.2
54	15.0	16.8	19.4
55	15.1	17.0	19.6
56	15.2	17.1	19.7
57	15.4	17.2	19.9
58	15.5	17.4	20.1
59	15.6	17.5	20.3

Appendix Table C.9 — Weight (kilograms) by Length of Boys, 49.0 to 90.5 centimeters

Length (cm)	Standard Deviations			Length (cm)	Standard Deviations		
	-1 S.D.	Median	+1 S.D.		-1 S.D.	Median	+1 S.D.
49.0	2.8	3.1	3.7	70.0	7.8	8.5	9.4
49.5	2.9	3.2	3.7	70.5	7.9	8.7	9.5
50.0	2.9	3.3	3.8	71.0	8.1	8.8	9.7
50.5	3.0	3.4	3.9	71.5	8.2	8.9	9.8
51.0	3.1	3.5	4.0	72.0	8.3	9.1	9.9
51.5	3.1	3.6	4.1	72.5	8.4	9.2	10.1
52.0	3.2	3.7	4.2	73.0	8.6	9.3	10.2
52.5	3.3	3.8	4.3	73.5	8.7	9.5	10.3
53.0	3.4	3.9	4.5	74.0	8.8	9.6	10.5
53.5	3.5	4.0	4.6	74.5	8.9	9.7	10.6
54.0	3.6	4.1	4.7	75.0	9.0	9.8	10.7
54.5	3.7	4.2	4.8	75.5	9.1	9.9	10.8
55.0	3.8	4.3	5.0	76.0	9.2	10.0	11.0
55.5	3.9	4.5	5.1	76.5	9.3	10.2	11.1
56.0	4.0	4.6	5.2	77.0	9.4	10.3	11.2
56.5	4.1	4.7	5.4	77.5	9.5	10.4	11.3
57.0	4.3	4.8	5.5	78.0	9.7	10.5	11.4
57.5	4.4	5.0	5.6	78.5	9.8	10.6	11.6
58.0	4.5	5.1	5.8	79.0	9.9	10.7	11.7
58.5	4.6	5.2	5.9	79.5	10.0	10.8	11.8
59.0	4.8	5.4	6.1	80.0	10.1	10.9	11.9
59.5	4.9	5.5	6.2	80.5	10.1	11.0	12.0
60.0	5.0	5.7	6.4	81.0	10.2	11.1	12.1
60.5	5.1	5.8	6.5	81.5	10.3	11.2	12.2
61.0	5.3	5.9	6.7	82.0	10.4	11.3	12.3
61.5	5.4	6.1	6.8	82.5	10.5	11.4	12.4
62.0	5.6	6.2	7.0	83.0	10.6	11.5	12.5
62.5	5.7	6.4	7.1	83.5	10.7	11.6	12.6
63.0	5.8	6.5	7.3	84.0	10.8	11.7	12.8
63.5	6.0	6.7	7.4	84.5	10.9	11.8	12.9
64.0	6.1	6.8	7.6	85.0	11.0	11.9	13.0
64.5	6.3	7.0	7.7	85.5	11.1	12.0	13.1
65.0	6.4	7.1	7.9	86.0	11.2	12.1	13.2
65.5	6.5	7.3	8.0	86.5	11.3	12.2	13.3
66.0	6.7	7.4	8.2	87.0	11.4	12.3	13.4
66.5	6.8	7.6	8.3	87.5	11.5	12.4	13.5
67.0	7.0	7.7	8.5	88.0	11.6	12.5	13.6
67.5	7.1	7.8	8.6	88.5	11.7	12.7	13.7
68.0	7.3	8.0	8.8	89.0	11.8	12.8	13.8
68.5	7.4	8.1	8.9	89.5	11.9	12.9	13.9
69.0	7.5	8.3	9.1	90.0	12.0	13.0	14.0
69.5	7.7	8.4	9.2	90.5	12.1	13.1	14.2

Appendix Table C.10 — Weight (kilograms) by Height of Boys, 55.0 to 130.0 centimeters

Height (cm)	Standard Deviations			Height (cm)	Standard Deviations		
	-1 S.D.	Median	+1 S.D.		-1 S.D.	Median	+1 S.D.
55.0	3.6	4.3	5.5	73.0	8.5	9.5	10.8
55.5	3.7	4.5	5.7	73.5	8.6	9.6	10.9
56.0	3.9	4.7	5.9	74.0	8.7	9.7	11.0
56.5	4.1	4.9	6.1	74.5	8.8	9.8	11.2
57.0	4.2	5.0	6.2	75.0	8.9	9.9	11.3
57.5	4.4	5.2	6.4	75.5	9.0	10.0	11.4
58.0	4.5	5.4	6.6	76.0	9.1	10.1	11.5
58.5	4.7	5.5	6.7	76.5	9.2	10.2	11.6
59.0	4.8	5.7	6.9	77.0	9.3	10.4	11.8
59.5	5.0	5.9	7.1	77.5	9.4	10.5	11.9
60.0	5.1	6.0	7.2	78.0	9.6	10.6	12.0
60.5	5.3	6.2	7.4	78.5	9.7	10.7	12.1
61.0	5.4	6.3	7.5	79.0	9.8	10.8	12.2
61.5	5.6	6.5	7.7	79.5	9.9	10.9	12.3
62.0	5.7	6.6	7.8	80.0	10.0	11.0	12.4
62.5	5.9	6.8	8.0	80.5	10.1	11.1	12.6
63.0	6.0	6.9	8.1	81.0	10.2	11.2	12.7
63.5	6.1	7.1	8.3	81.5	10.3	11.3	12.8
64.0	6.3	7.2	8.4	82.0	10.4	11.5	12.9
64.5	6.4	7.3	8.6	82.5	10.5	11.6	13.0
65.0	6.5	7.5	8.7	83.0	10.6	11.7	13.1
65.5	6.7	7.6	8.9	83.5	10.7	11.8	13.2
66.0	6.8	7.7	9.0	84.0	10.8	11.9	13.3
66.5	6.9	7.9	9.1	84.5	10.9	12.0	13.5
67.0	7.0	8.0	9.3	85.0	11.0	12.1	13.6
67.5	7.2	8.1	9.4	85.5	11.1	12.2	13.7
68.0	7.3	8.3	9.5	86.0	11.2	12.3	13.8
68.5	7.4	8.4	9.7	86.5	11.3	12.5	13.9
69.0	7.5	8.5	9.8	87.0	11.5	12.6	14.0
69.5	7.7	8.6	9.9	87.5	11.6	12.7	14.1
70.0	7.8	8.8	10.1	88.0	11.7	12.8	14.3
70.5	7.9	8.9	10.2	88.5	11.8	12.9	14.4
71.0	8.0	9.0	10.3	89.0	11.9	13.0	14.5
71.5	8.1	9.1	10.4	89.5	12.0	13.1	14.6
72.0	8.2	9.2	10.6	90.0	12.1	13.3	14.7
72.5	8.3	9.3	10.7	90.5	12.2	13.4	14.8

Appendix Table C.10 (continued)

Height (cm)	Standard Deviations		
	-1 S.D.	Median	+1 S.D.
91.0	12.3	13.5	15.0
91.5	12.4	13.6	15.1
92.0	12.5	13.7	15.2
92.5	12.6	13.9	15.3
93.0	12.8	14.0	15.4
93.5	12.9	14.1	15.6
94.0	13.0	14.2	15.7
94.5	13.1	14.3	15.8
95.0	13.2	14.5	15.9
95.5	13.3	14.6	16.1
96.0	13.4	14.7	16.2
96.5	13.5	14.8	16.3
97.0	13.7	15.0	16.5
97.5	13.8	15.1	16.6
98.0	13.9	15.2	16.7
98.5	14.0	15.4	16.9
99.0	14.1	15.5	17.0
99.5	14.3	15.6	17.1
100.0	14.4	15.7	17.3
100.5	14.5	15.9	17.4
101.0	14.6	16.0	17.5
101.5	14.7	16.2	17.7
102.0	14.9	16.3	17.8
102.5	15.0	16.4	18.0
103.0	15.1	16.6	18.1
103.5	15.3	16.7	18.3
104.0	15.4	16.9	18.4
104.5	15.5	17.0	18.6
105.0	15.6	17.1	18.8
105.5	15.8	17.3	18.9
106.0	15.9	17.4	19.1
106.5	16.1	17.6	19.2
107.0	16.2	17.7	19.4
107.5	16.3	17.9	19.6
108.0	16.5	18.0	19.7
108.5	16.6	18.2	19.9
109.0	16.8	18.3	20.1
109.5	16.9	18.5	20.3
110.0	17.1	18.7	20.4
110.5	17.2	18.8	20.6
111.0	17.4	19.0	20.8
111.5	17.5	19.1	21.0
112.0	17.7	19.3	21.2
112.5	17.8	19.5	21.4
113.0	18.0	19.6	21.6
113.5	18.1	19.8	21.8
114.0	18.3	20.0	22.0
114.5	18.5	20.2	22.2
115.0	18.6	20.3	22.4
115.5	18.8	20.5	22.6
116.0	18.9	20.7	22.8
116.5	19.1	20.9	23.0
117.0	19.3	21.1	23.2
117.5	19.5	21.2	23.5
118.0	19.6	21.4	23.7
118.5	19.8	21.6	23.9
119.0	20.0	21.8	24.2
119.5	20.2	22.0	24.4
120.0	20.4	22.2	24.6
120.5	20.6	22.4	24.9
121.0	20.7	22.6	25.1
121.5	20.9	22.8	25.4
122.0	21.1	23.0	25.6
122.5	21.3	23.2	25.9
123.0	21.5	23.4	26.2
123.5	21.7	23.6	26.4
124.0	21.9	23.9	26.7
124.5	22.1	24.1	27.0
125.0	22.3	24.3	27.2
125.5	22.5	24.5	27.5
126.0	22.8	24.8	27.8
126.5	23.0	25.0	28.1
127.0	23.2	25.2	28.4
127.5	23.4	25.5	28.7
128.0	23.6	25.7	29.0
128.5	23.8	26.0	29.3
129.0	24.1	26.2	29.7
129.5	24.3	26.5	30.0
130.0	24.5	26.8	30.3

Appendix Table C.11 — Weight (kilograms) by Length of Girls, 49.0 to 90.5 centimeters

Length (cm)	Standard Deviations			Length (cm)	Standard Deviations		
	-1 S.D.	Median	+1 S.D.		-1 S.D.	Median	+1 S.D.
49.0	2.9	3.3	3.6	70.0	7.6	8.4	9.1
49.5	3.0	3.4	3.7	70.5	7.7	8.5	9.3
50.0	3.0	3.4	3.8	71.0	7.8	8.6	9.4
50.5	3.1	3.5	3.9	71.5	8.0	8.8	9.5
51.0	3.1	3.5	4.0	72.0	8.1	8.9	9.7
51.5	3.2	3.6	4.1	72.5	8.2	9.0	9.8
52.0	3.3	3.7	4.2	73.0	8.3	9.1	9.9
52.5	3.4	3.8	4.3	73.5	8.4	9.3	10.0
53.0	3.4	3.9	4.4	74.0	8.5	9.4	10.2
53.5	3.5	4.0	4.5	74.5	8.6	9.5	10.3
54.0	3.6	4.1	4.6	75.0	8.7	9.6	10.4
54.5	3.7	4.2	4.7	75.5	8.8	9.7	10.5
55.0	3.8	4.3	4.9	76.0	8.9	9.8	10.6
55.5	3.9	4.4	5.0	76.5	9.0	9.9	10.7
56.0	4.0	4.5	5.1	77.0	9.1	10.0	10.8
56.5	4.1	4.6	5.3	77.5	9.2	10.1	11.0
57.0	4.2	4.8	5.4	78.0	9.3	10.2	11.1
57.5	4.3	4.9	5.5	78.5	9.4	10.3	11.2
58.0	4.4	5.0	5.7	79.0	9.5	10.4	11.3
58.5	4.6	5.1	5.8	79.5	9.6	10.5	11.4
59.0	4.7	5.3	5.9	80.0	9.7	10.6	11.5
59.5	4.8	5.4	6.1	80.5	9.8	10.7	11.6
60.0	4.9	5.5	6.2	81.0	9.9	10.8	11.7
60.5	5.1	5.7	6.4	81.5	10.0	10.9	11.8
61.0	5.2	5.8	6.5	82.0	10.1	11.0	11.9
61.5	5.3	6.0	6.7	82.5	10.2	11.1	12.0
62.0	5.4	6.1	6.8	83.0	10.3	11.2	12.1
62.5	5.6	6.2	7.0	83.5	10.4	11.3	12.2
63.0	5.7	6.4	7.1	84.0	10.5	11.4	12.3
63.5	5.8	6.5	7.3	84.5	10.6	11.5	12.4
64.0	6.0	6.7	7.4	85.0	10.6	11.6	12.5
64.5	6.1	6.8	7.6	85.5	10.7	11.7	12.6
65.0	6.3	7.0	7.7	86.0	10.8	11.8	12.7
65.5	6.4	7.1	7.9	86.5	10.9	11.8	12.8
66.0	6.5	7.3	8.0	87.0	11.0	11.9	12.9
66.5	6.7	7.4	8.1	87.5	11.1	12.0	13.0
67.0	6.8	7.5	8.3	88.0	11.2	12.2	13.1
67.5	6.9	7.7	8.4	88.5	11.3	12.3	13.2
68.0	7.1	7.8	8.6	89.0	11.4	12.4	13.3
68.5	7.2	8.0	8.7	89.5	11.5	12.5	13.4
69.0	7.3	8.1	8.9	90.0	11.6	12.6	13.6
69.5	7.5	8.2	9.0	90.5	11.7	12.7	13.7

Appendix Table C.12 – Weight (kilograms) by Height of Girls, 55.0 to 130.0 centimeters

Height (cm)	Standard Deviations			Height (cm)	Standard Deviations		
	-1 S.D.	Median	+1 S.D.		-1 S.D.	Median	+1 S.D.
55.0	3.6	4.3	5.5	73.0	8.3	9.3	10.6
55.5	3.8	4.5	5.7	73.5	8.4	9.4	10.7
56.0	3.9	4.7	5.9	74.0	8.5	9.5	10.8
56.5	4.1	4.8	6.0	74.5	8.6	9.6	10.9
57.0	4.2	5.0	6.2	75.0	8.7	9.7	11.0
57.5	4.4	5.2	6.4	75.5	8.8	9.9	11.1
58.0	4.5	5.3	6.6	76.0	8.9	10.0	11.2
58.5	4.7	5.5	6.7	76.5	9.0	10.1	11.3
59.0	4.8	5.7	6.9	77.0	9.1	10.2	11.5
59.5	5.0	5.8	7.0	77.5	9.2	10.3	11.6
60.0	5.1	6.0	7.2	78.0	9.3	10.4	11.7
60.5	5.3	6.1	7.3	78.5	9.4	10.5	11.8
61.0	5.4	6.3	7.5	79.0	9.5	10.6	11.9
61.5	5.5	6.4	7.6	79.5	9.7	10.7	12.0
62.0	5.7	6.6	7.8	80.0	9.8	10.8	12.1
62.5	5.8	6.7	7.9	80.5	9.9	10.9	12.2
63.0	5.9	6.9	8.1	81.0	10.0	11.0	12.3
63.5	6.1	7.0	8.2	81.5	10.1	11.1	12.4
64.0	6.2	7.1	8.4	82.0	10.2	11.2	12.5
64.5	6.3	7.3	8.5	82.5	10.3	11.3	12.6
65.0	6.4	7.4	8.6	83.0	10.4	11.4	12.8
65.5	6.6	7.5	8.8	83.5	10.5	11.5	12.9
66.0	6.7	7.7	8.9	84.0	10.6	11.6	13.0
66.5	6.8	7.8	9.0	84.5	10.7	11.7	13.1
67.0	6.9	7.9	9.1	85.0	10.8	11.8	13.2
67.5	7.0	8.0	9.3	85.5	10.9	11.9	13.3
68.0	7.2	8.2	9.4	86.0	11.0	12.0	13.4
68.5	7.3	8.3	9.5	86.5	11.1	12.2	13.5
69.0	7.4	8.4	9.6	87.0	11.2	12.3	13.7
69.5	7.5	8.5	9.8	87.5	11.3	12.4	13.8
70.0	7.6	8.6	9.9	88.0	11.4	12.5	13.9
70.5	7.7	8.8	10.0	88.5	11.5	12.6	14.0
71.0	7.9	8.9	10.1	89.0	11.6	12.7	14.1
71.5	8.0	9.0	10.2	89.5	11.7	12.8	14.2
72.0	8.1	9.1	10.3	90.0	11.8	12.9	14.4
72.5	8.2	9.2	10.5	90.5	11.9	13.0	14.5

Appendix Table C.12 (continued)

Height (cm)	Standard Deviations			Height (cm)	Standard Deviations		
	-1 S.D.	Median	+1 S.D.		-1 S.D.	Median	+1 S.D.
91.0	12.0	13.2	14.6	112.0	17.2	18.9	20.9
91.5	12.1	13.3	14.7	112.5	17.4	19.0	21.1
92.0	12.2	13.4	14.9	113.0	17.5	19.2	21.3
92.5	12.3	13.5	15.0	113.5	17.7	19.4	21.5
93.0	12.4	13.6	15.1	114.0	17.9	19.5	21.7
93.5	12.5	13.7	15.2	114.5	18.0	19.7	21.9
94.0	12.6	13.9	15.4	115.0	18.2	19.9	22.1
94.5	12.8	14.0	15.5	115.5	18.4	20.1	22.3
95.0	12.9	14.1	15.6	116.0	18.5	20.3	22.5
95.5	13.0	14.2	15.8	116.5	18.7	20.4	22.7
96.0	13.1	14.3	15.9	117.0	18.9	20.6	23.0
96.5	13.2	14.5	16.0	117.5	19.0	20.8	23.2
97.0	13.3	14.6	16.2	118.0	19.2	21.0	23.4
97.5	13.4	14.7	16.3	118.5	19.4	21.2	23.7
98.0	13.5	14.9	16.5	119.0	19.6	21.4	23.9
98.5	13.7	15.0	16.6	119.5	19.8	21.6	24.1
99.0	13.8	15.1	16.7	120.0	20.0	21.8	24.4
99.5	13.9	15.2	16.9	120.5	20.1	22.0	24.7
100.0	14.0	15.4	17.0	121.0	20.3	22.2	24.9
100.5	14.1	15.5	17.2	121.5	20.5	22.5	25.2
101.0	14.3	15.6	17.3	122.0	20.7	22.7	25.5
101.5	14.4	15.8	17.5	122.5	20.9	22.9	25.8
102.0	14.5	15.9	17.6	123.0	21.1	23.1	26.1
102.5	14.6	16.0	17.8	123.5	21.3	23.4	26.4
103.0	14.7	16.2	17.9	124.0	21.6	23.6	26.7
103.5	14.9	16.3	18.1	124.5	21.8	23.9	27.0
104.0	15.0	16.5	18.2	125.0	22.0	24.1	27.3
104.5	15.1	16.6	18.4	125.5	22.2	24.3	27.6
105.0	15.3	16.7	18.5	126.0	22.4	24.6	28.0
105.5	15.4	16.9	18.7	126.5	23.7	24.9	28.3
106.0	15.5	17.0	18.9	127.0	22.9	25.1	28.6
106.5	15.7	17.2	19.0	127.5	23.1	25.4	29.0
107.0	15.8	17.3	19.2	128.0	23.3	25.7	29.4
107.5	15.9	17.5	19.3	128.5	23.6	25.9	29.7
108.0	16.1	17.6	19.5	129.0	23.8	26.2	30.1
108.5	16.2	17.8	19.7	129.5	24.1	26.5	30.5
				130.0	24.3	26.8	30.9
109.0	16.4	17.9	19.8				
109.5	16.5	18.1	20.0				
110.0	16.6	18.2	20.2				
110.5	16.8	18.4	20.4				
111.0	16.9	18.6	20.6				
111.5	17.1	18.7	20.7				

APPENDIX D

RAPID ASSESSMENT OF NUTRITIONAL STATUS BASED ON NCHS/WHO CHILD GROWTH REFERENCE VALUES
(WHO/Brazzaville n.d.)

LENGTH OR HEIGHT FOR AGE
(Children under 2.0 yrs - length. Children above 2.0 yrs - height)

BOYS

AGE MONTHS	LENGTH (CM) FOR AGE MEDIAN	-1SD	-2SD	-3SD
0	50.5	48.2	45.9	43.6
1	54.6	52.1	49.7	47.2
2	58.1	55.5	52.9	50.4
3	61.1	58.5	55.8	53.2
4	63.7	61.0	58.3	55.6
5	66.9	63.2	60.5	57.8
6	67.8	65.1	62.4	59.8
7	69.5	66.8	64.1	61.5
8	71.0	68.3	65.7	63.0
9	72.3	69.7	67.0	64.4
10	73.6	71.0	68.3	65.7
11	74.9	72.2	69.6	66.9
12	76.1	73.4	70.7	68.0
13	77.2	74.5	71.8	69.0
14	78.3	75.6	72.8	70.0
15	79.4	76.6	73.7	70.9
16	80.4	77.5	74.6	71.7
17	81.4	78.5	75.5	72.5
18	82.4	79.4	76.3	73.3
19	83.3	80.2	77.1	74.0
20	84.2	81.1	77.9	74.7
21	85.1	81.9	78.7	75.4
22	86.0	82.7	79.4	76.1
23	86.8	83.5	80.2	76.8
	A	B	C	D

AGE YR	MTH	HEIGHT (CM) FOR AGE MEDIAN	-1SD	-2SD	-3SD
2	0	85.6	82.4	79.2	76.0
2	1	86.4	83.2	79.9	76.7
2	2	87.2	83.9	80.6	77.3
2	3	88.1	84.7	81.3	78.0
2	4	88.9	85.4	82.0	78.6
2	5	89.7	86.2	82.7	79.2
2	6	90.4	86.9	83.4	79.9
2	7	91.2	87.6	84.1	80.5
2	8	92.0	88.3	84.7	81.1
2	9	92.7	89.0	85.4	81.7
2	10	93.5	89.7	86.0	82.3
2	11	94.2	90.4	86.7	82.9
		A	B	C	D

AGE YRS	MTHS	HEIGHT (CM) FOR AGE MEDIAN	-1SD	-2SD	-3SD
3	0	94.9	91.1	87.3	83.5
3	1	95.6	91.8	87.9	84.1
3	2	96.3	92.4	88.6	84.7
3	3	97.0	93.1	89.2	85.2
3	4	97.7	93.8	89.8	85.8
3	5	98.4	94.4	90.4	86.4
3	6	99.1	95.0	91.0	86.9
3	7	99.7	95.7	91.6	87.5
3	8	100.4	96.3	92.1	88.0
3	9	101.0	96.9	92.7	88.6
3	10	101.7	97.5	93.3	89.1
3	11	102.3	98.1	93.9	89.6
4	0	102.9	98.7	94.4	90.2
4	1	103.6	99.0	95.0	90.7
4	2	104.2	99.9	95.5	91.2
4	3	104.8	100.4	96.1	91.7
4	4	105.4	101.0	96.6	92.2
4	5	106.0	101.6	97.1	92.7
4	6	106.6	102.1	97.7	93.2
4	7	107.1	102.7	98.2	93.7
4	8	107.7	103.2	98.7	94.2
4	9	108.3	103.7	99.2	94.7
4	10	108.8	104.3	99.7	95.2
4	11	109.4	104.8	100.2	95.7
		A	B	C	D

GIRLS

AGE MONTHS	LENGTH (CM) FOR AGE MEDIAN	-1SD	-2SD	-3SD
0	49.9	47.7	45.5	43.4
1	53.5	51.2	49.0	46.7
2	56.8	54.4	52.0	49.6
3	59.5	57.1	54.6	52.1
4	62.0	59.4	56.9	54.3
5	64.1	61.5	58.9	56.3
6	65.9	63.3	60.6	58.0
7	67.6	64.9	62.2	59.5
8	69.1	66.4	63.7	60.9
9	70.4	67.7	65.0	62.2
10	71.8	69.0	66.2	63.5
11	73.1	70.3	67.5	64.7
12	74.3	71.5	68.6	65.8
13	75.5	72.6	69.6	66.9
14	76.7	73.7	70.8	67.9
15	77.8	74.8	71.9	68.9
16	78.9	75.9	72.9	69.9
17	79.9	76.9	73.8	70.8
18	80.9	77.9	74.6	71.7
19	81.9	78.8	75.7	72.6
20	82.9	79.7	76.6	73.4
21	83.8	80.6	77.4	74.3
22	84.7	81.5	78.3	75.1
23	85.6	82.4	79.1	75.9
	A	B	C	D

AGE YR	MTH	HEIGHT (CM) FOR AGE MEDIAN	-1SD	-2SD	-3SD
2	0	84.5	81.3	78.1	74.9
2	1	85.4	82.1	78.8	75.6
2	2	86.2	82.9	79.6	76.3
2	3	87.0	83.7	80.3	77.0
2	4	87.9	84.5	81.0	77.6
2	5	88.7	85.2	81.8	78.3
2	6	89.5	86.0	82.5	79.0
2	7	90.2	86.7	83.2	79.6
2	8	91.0	87.4	83.8	80.3
2	9	91.7	88.1	84.5	80.9
2	10	92.5	88.8	85.2	81.5
2	11	93.2	89.5	85.8	82.1
		A	B	C	D

AGE YRS	MTHS	HEIGHT (CM) FOR AGE MEDIAN	-1SD	-2SD	-3SD
3	0	93.9	90.2	86.5	82.8
3	1	94.6	90.9	87.1	83.4
3	2	95.3	91.5	87.7	84.0
3	3	96.0	92.2	88.4	84.5
3	4	96.6	92.8	89.0	85.0
3	5	97.3	93.4	89.6	85.7
3	6	97.9	94.0	90.2	86.3
3	7	98.6	94.7	90.7	86.8
3	8	99.2	95.3	91.3	87.4
3	9	99.8	95.8	91.9	87.9
3	10	100.4	96.4	92.4	88.4
3	11	101.0	97.0	93.0	89.0
4	0	101.6	97.6	93.5	89.5
4	1	102.2	98.1	94.1	90.0
4	2	102.8	98.7	94.6	90.5
4	3	103.4	99.3	95.1	91.0
4	4	104.0	99.8	95.6	91.5
4	5	104.5	100.3	96.1	92.0
4	6	105.1	100.9	96.7	92.4
4	7	105.6	101.4	97.1	92.9
4	8	106.2	101.9	97.6	93.4
4	9	106.7	102.4	98.1	93.8
4	10	107.3	102.9	98.6	94.3
4	11	107.8	103.5	99.1	94.7
		A	B	C	D

'A' denotes "normal 'B' = possible mild undernutrition or stunting (chronic) 'C' = moderate undernutrition or stunting (chronic) 'D' = severe undernutrition (dwarfing) SD = Standard Deviation

Appendix D (continued)

WEIGHT (KG) FOR HEIGHT - PRESCHOOL AND SCHOOL AGE

BOYS

HEIGHT CM	MEDIAN	-1SD	-2SD	-3SD
55	4.3	3.6	2.8	2.0
56	4.7	3.9	3.1	2.3
57	5.0	4.2	3.4	2.6
58	5.4	4.5	3.7	2.8
59	5.7	4.8	4.0	3.1
60	6.0	5.1	4.2	3.4
61	6.3	5.4	4.5	3.6
62	6.6	5.7	4.8	3.9
63	6.9	6.0	5.1	4.1
64	7.2	6.3	5.3	4.4
65	7.5	6.5	5.6	4.6
66	7.7	6.8	5.8	4.9
67	8.0	7.0	6.1	5.1
68	8.3	7.3	6.3	5.3
69	8.5	7.5	6.6	5.6
70	8.8	7.8	6.8	5.8
71	9.0	8.0	7.0	6.0
72	9.2	8.2	7.2	6.3
73	9.5	8.5	7.5	6.5
74	9.7	8.7	7.7	6.7
75	9.9	8.9	7.9	6.9
76	10.1	9.1	8.1	7.1
77	10.4	9.3	8.3	7.3
78	10.6	9.6	8.5	7.5
79	10.8	9.8	8.7	7.7
80	11.0	10.0	8.9	7.9
81	11.2	10.2	9.1	8.1
82	11.5	10.4	9.3	8.3
83	11.7	10.6	9.5	8.5
84	11.9	10.8	9.7	8.7
85	12.1	11.0	9.9	8.9
86	12.3	11.2	10.1	9.0
87	12.6	11.5	10.3	9.2
88	12.8	11.7	10.5	9.4
89	13.0	11.9	10.7	9.6
90	13.3	12.1	10.9	9.8
91	13.5	12.3	11.1	9.9
92	13.7	12.5	11.3	10.1
93	14.0	12.8	11.5	10.3
94	14.2	13.0	11.7	10.5
95	14.5	13.2	11.9	10.7
96	14.7	13.4	12.1	10.9
97	15.0	13.7	12.4	11.0
98	15.2	13.9	12.6	11.2
99	15.5	14.1	12.8	11.4
	A	B	C	D

HEIGHT CM	MEDIAN	-1SD	-2SD	-3SD
100	15.7	14.4	13.0	11.6
101	16.0	14.6	13.2	11.8
102	16.3	14.9	13.4	12.0
103	16.6	15.1	13.7	12.2
104	16.9	15.4	13.9	12.4
105	17.1	15.6	14.2	12.7
106	17.4	15.9	14.4	12.9
107	17.7	16.2	14.7	13.1
108	18.0	16.5	14.9	13.4
109	18.3	16.8	15.2	13.6
110	18.7	17.1	15.4	13.8
111	19.0	17.4	15.7	14.1
112	19.3	17.7	16.0	14.4
113	19.6	18.0	16.3	14.6
114	20.0	18.3	16.6	14.9
115	20.3	18.6	16.9	15.2
116	20.7	18.9	17.2	15.5
117	21.1	19.3	17.5	15.8
118	21.4	19.6	17.9	16.1
119	21.8	20.0	18.2	16.4
120	22.2	20.4	18.5	16.7
121	22.6	20.7	18.9	17.0
122	23.0	21.1	19.2	17.4
123	23.4	21.5	19.6	17.7
124	23.9	21.9	20.0	18.0
125	24.3	22.3	20.4	18.4
126	24.8	22.8	20.7	18.7
127	25.2	23.2	21.1	19.1
128	25.7	23.6	21.5	19.4
129	26.2	24.1	21.9	19.8
130	26.8	24.5	22.3	20.1
131	27.3	25.0	22.7	20.4
132	27.8	25.5	23.1	20.8
133	28.4	26.0	23.6	21.1
134	29.0	26.5	24.0	21.5
135	29.6	27.0	24.4	21.8
136	30.2	27.5	24.8	22.1
137	30.9	28.1	25.3	22.4
138	31.6	28.6	25.7	22.8
139	32.3	29.2	26.1	23.1
140	33.0	29.8	26.6	23.4
141	33.7	30.4	27.0	23.7
142	34.5	31.0	27.5	24.0
143	35.2	31.6	27.9	24.2
144	36.1	32.2	28.4	24.5
145	36.9	32.8	28.8	24.8
	A	B	C	D

GIRLS

HEIGHT CM	MEDIAN	-1SD	-2SD	-3SD
55	4.3	3.6	3.0	2.3
56	4.7	3.9	3.2	2.5
57	5.0	4.2	3.5	2.7
58	5.3	4.5	3.8	3.0
59	5.7	4.8	4.0	3.2
60	6.0	5.1	4.3	3.4
61	6.3	5.4	4.5	3.6
62	6.6	5.7	4.8	3.9
63	6.9	5.9	5.0	4.1
64	7.1	6.2	5.2	4.3
65	7.4	6.4	5.5	4.5
66	7.7	6.7	5.7	4.7
67	7.9	6.9	5.9	5.0
68	8.2	7.2	6.2	5.2
69	8.4	7.4	6.4	5.4
70	8.6	7.6	6.6	5.6
71	8.9	7.9	6.8	5.8
72	9.1	8.1	7.1	6.0
73	9.3	8.3	7.3	6.2
74	9.5	8.5	7.5	6.5
75	9.7	8.7	7.7	6.7
76	10.0	8.9	7.9	6.9
77	10.2	9.1	8.1	7.1
78	10.4	9.3	8.3	7.3
79	10.6	9.5	8.5	7.5
80	10.8	9.8	8.7	7.7
81	11.0	10.0	8.9	7.9
82	11.2	10.2	9.1	8.1
83	11.4	10.4	9.3	8.3
84	11.6	10.6	9.5	8.4
85	11.8	10.8	9.7	8.6
86	12.0	11.0	9.9	8.8
87	12.3	11.2	10.1	9.0
88	12.5	11.4	10.3	9.2
89	12.7	11.6	10.5	9.3
90	12.9	11.8	10.7	9.5
91	13.2	12.0	10.8	9.7
92	13.4	12.2	11.0	9.9
93	13.6	12.4	11.2	10.0
94	13.9	12.6	11.4	10.2
95	14.1	12.9	11.6	10.4
96	14.3	13.1	11.8	10.6
97	14.5	13.3	12.0	10.7
98	14.9	13.5	12.2	10.9
99	15.1	13.8	12.4	11.1
	A	B	C	D

HEIGHT CM	MEDIAN	-1SD	-2SD	-3SD
100	15.4	14.0	12.7	11.3
101	15.6	14.3	12.9	11.5
102	15.9	14.5	13.1	11.7
103	16.2	14.7	13.3	11.9
104	16.5	15.0	13.5	12.1
105	16.7	15.3	13.8	12.3
106	17.0	15.5	14.0	12.5
107	17.3	15.8	14.3	12.7
108	17.6	16.1	14.5	13.0
109	17.9	16.4	14.8	13.2
110	18.2	16.6	15.0	13.4
111	18.6	16.9	15.3	13.7
112	18.9	17.2	15.6	14.0
113	19.2	17.5	15.9	14.2
114	19.5	17.9	16.2	14.5
115	19.9	18.2	16.5	14.8
116	20.3	18.5	16.8	15.0
117	20.6	18.9	17.1	15.3
118	21.0	19.2	17.4	15.6
119	21.4	19.6	17.7	15.9
120	21.8	20.0	18.1	16.2
121	22.2	20.3	18.4	16.5
122	22.7	20.7	18.8	16.8
123	23.1	21.1	19.1	17.1
124	23.6	21.6	19.5	17.4
125	24.1	22.0	19.9	17.8
126	24.6	22.4	20.2	18.1
127	25.1	22.9	20.6	18.4
128	25.9	23.6	21.2	18.9
129	26.5	24.1	21.6	19.2
130	26.8	24.3	21.8	19.4
131	27.4	24.8	22.3	19.7
132	28.0	25.4	22.7	20.0
133	28.7	25.9	23.1	20.4
134	29.4	26.5	23.6	20.7
135	30.1	27.0	24.0	21.0
136	30.8	27.6	24.5	21.3
137	31.5	28.2	25.0	21.7
	A	B	C	D

'A' denotes "normal

'B' = possible mild PEM (acute)

'C' = moderate PEM (acute)

'D' = severe PEM (acute)

Appendix D (continued)

WEIGHT (KG) FOR AGE

BOYS

AGE MONTHS	MEDIAN	-1SD	-2SD	-3SD	AGE YRS	AGE MTHS	MEDIAN	-1SD	-2SD	-3SD
0	3.3	2.9	2.4	2.0						
1	4.3	3.6	2.9	2.2	3	0	14.6	13.0	11.4	9.8
2	5.2	4.3	3.5	2.6	3	1	14.8	13.2	11.5	9.9
3	6.0	5.0	4.1	3.1	3	2	15.0	13.3	11.7	10.0
4	6.7	5.7	4.7	3.7	3	3	15.2	13.5	11.8	10.1
5	7.3	6.3	5.3	4.3	3	4	15.3	13.6	11.9	10.2
6	7.8	6.9	5.9	4.9	3	5	15.5	13.8	12.0	10.3
7	8.3	7.4	6.4	5.4	3	6	15.7	13.9	12.1	10.4
8	8.8	7.8	6.9	5.9	3	7	15.8	14.1	12.3	10.5
9	9.2	8.2	7.2	6.3	3	8	16.0	14.2	12.4	10.6
10	9.5	8.6	7.6	6.6	3	9	16.2	14.4	12.5	10.7
11	9.9	8.9	7.9	6.9	3	10	16.4	14.5	12.6	10.8
12	10.2	9.1	8.1	7.1	3	11	16.5	14.6	12.8	10.9
13	10.4	9.4	8.3	7.3	4	0	16.7	14.8	12.9	11.0
14	10.7	9.6	8.5	7.5	4	1	16.9	14.9	13.0	11.1
15	10.9	9.8	8.7	7.6	4	2	17.0	15.1	13.1	11.2
16	11.1	10.0	8.8	7.7	4	3	17.2	15.2	13.3	11.3
17	11.3	10.1	9.0	7.8	4	4	17.4	15.4	13.4	11.4
18	11.5	10.3	9.1	7.9	4	5	17.5	15.5	13.5	11.5
19	11.7	10.5	9.2	8.0	4	6	17.7	15.7	13.7	11.6
20	11.8	10.6	9.4	8.1	4	7	17.9	15.8	13.8	11.8
21	12.0	10.8	9.5	8.3	4	8	18.0	16.0	13.9	11.9
22	12.2	10.9	9.7	8.4	4	9	18.2	16.1	14.0	12.0
23	12.4	11.1	9.8	8.5	4	10	18.3	16.3	14.2	12.1
24	12.6	11.3	9.9	8.6	4	11	18.5	16.4	14.3	12.2
25	12.8	11.4	10.1	8.7						
26	13.0	11.6	10.2	8.8						
27	13.1	11.7	10.3	8.9						
28	13.3	11.9	10.5	9.1						
29	13.5	12.1	10.6	9.2						
30	13.7	12.2	10.8	9.3						
31	13.8	12.4	10.9	9.4						
32	14.0	12.5	11.0	9.5						
33	14.2	12.7	11.2	9.7						
34	14.4	12.8	11.3	9.8						
35	14.5	13.0	11.4	9.9						
	A	B	C	D			A	B	C	D

GIRLS

AGE MONTHS	MEDIAN	-1SD	-2SD	-3SD	AGE YRS	AGE MTHS	MEDIAN	-1SD	-2SD	-3SD
0	3.2	2.7	2.2	1.8						
1	4.0	3.4	2.8	2.2	3	0	14.1	12.6	11.2	9.7
2	4.7	4.0	3.3	2.7	3	1	14.3	12.8	11.3	9.8
3	5.4	4.7	3.9	3.2	3	2	14.4	12.9	11.4	9.9
4	5.0	5.3	4.5	3.7	3	3	14.6	13.1	11.5	10.0
5	6.7	5.8	5.0	4.1	3	4	14.8	13.2	11.6	10.1
6	7.2	6.3	5.5	4.6	3	5	14.9	13.3	11.8	10.2
7	7.7	6.8	5.9	5.0	3	6	15.1	13.5	11.9	10.3
8	8.2	7.2	6.3	5.3	3	7	15.2	13.6	12.0	10.4
9	8.6	7.6	6.6	5.7	3	8	15.4	13.7	12.1	10.5
10	8.9	8.9	6.9	5.9	3	9	15.5	13.9	12.2	10.6
11	9.2	8.2	7.2	6.2	3	10	15.7	14.0	12.3	10.7
12	9.5	8.5	7.4	6.4	3	11	15.8	14.1	12.4	10.8
13	9.8	8.7	7.6	6.6	4	0	16.0	14.3	12.6	10.9
14	10.0	8.9	7.8	6.7	4	1	16.1	14.4	12.7	10.9
15	10.2	9.1	8.0	6.9	4	2	16.2	14.5	12.8	11.0
16	10.4	9.3	8.2	7.0	4	3	16.4	14.6	12.9	11.1
17	10.6	9.5	8.3	7.2	4	4	16.5	14.8	13.0	11.2
18	10.8	9.7	8.5	7.3	4	5	16.7	14.9	13.1	11.3
19	11.0	9.8	8.6	7.5	4	6	16.8	15.0	13.2	11.4
20	11.2	10.0	8.8	7.6	4	7	17.0	15.1	13.3	11.5
21	11.4	10.2	9.0	7.7	4	8	17.1	15.2	13.4	11.5
22	11.5	10.3	9.1	7.9	4	9	17.2	15.4	13.5	11.6
23	11.7	10.5	9.3	8.0	4	10	17.4	15.5	13.6	11.7
24	11.9	10.7	9.4	8.2	4	11	17.5	15.6	13.7	11.8
25	12.1	10.8	9.6	8.3						
26	12.3	11.0	9.7	8.5						
27	12.4	11.2	9.9	8.6						
28	12.6	11.3	10.1	8.8						
29	12.8	11.5	10.2	8.9						
30	12.9	11.6	10.3	9.1						
31	13.1	11.8	19.5	9.2						
32	13.3	11.9	10.6	9.3						
33	13.4	12.1	10.7	9.4						
34	13.6	12.2	10.9	9.5						
35	13.8	12.4	11.0	9.6						
	A	B	C	D			A	B	C	D

'A' denotes "normal; 'B' = possible mild ; ; (acute or chron.c) 'C' = moderate PEM; (acute or chronic) 'D' = severe PEM (ma- mus) (acute or chroni

SD = Standard Deviation
PEM = Protein Energy Malnutrition

REFERENCES

Alnwick, D. J. 1985. Resources for Growth Monitoring. Nairobi: UNICEF Eastern and Southern Africa Regional Office. Photocopy.

Alnwick, D. J. 1980. *The Weight, Length and Mid Upper Arm Circumference of Kenyan Children in Nairobi Nursery Schools*. UNICEF Social Statistics Bulletin. Nairobi: UNICEF Eastern and Southern Africa Regional Office.

Appleton, J. 1987. *Drought Relief in Ethiopia: Planning and Management of Feeding Programmes - A Practical Guide*. London: Save the Children Fund.

Dibley, M. J., N. Staehling, P. Nieburg, and F. L. Trowbridge. 1987. "Interpretation of Z-Score Anthropometric Indicators Derived from the International Growth Reference." *American Journal of Clinical Nutrition*. 46: 749-762.

Dustin, J., G. Lavoipierre, H. Dixon, and W. Keller. 1974. A Guideline for the Measurement of Nutritional Impact of Supplementary Feeding Programmes Aimed at Vulnerable Groups. Geneva: World Health Organization. Photocopy.

Griffiths, M. 1985. *Growth Monitoring of Preschool Children: Practical Considerations for Primary Health Care Projects*. Washington, DC: American Public Health Association.

Habicht, J.-P. 1974. "Estandardizacion de Metodos Epidemiologicos Cuantitativos Sobre el Terreno." *Boletin de la Oficina Sanitaria Panamericana*. 76: 375-384.

Habicht, J.-P., R. Martorell, C. Yarbrough, R. Malina, and R. Klein. 1974. "Height and Weight Standards for Preschool Children: How Relevant are Ethnic Differences in Growth Potential?" *Lancet I* (April): 611-615.

Martorell, R. 1982. *Nutrition and Health Status Indicators: Suggestions for Surveys of the Standard of Living in Developing Countries*. Living Standards Measurement Study Working Paper No. 13. Washington, DC: World Bank.

Martorell, R., and J.-P. Habicht. 1986. "Growth in Early Childhood in Developing Countries." In *Human Growth: A Comprehensive Treatise*. Second Edition. Volume 3. *Methodology: Ecological, Genetic, and Nutritional Effects on Growth*. Frank Falkner and J.M. Tanner, eds. New York and London: Plenum Press.

Republic of Kenya. 1983. *Report of the Third Rural Child Nutrition Survey 1982*. Nairobi: Central Bureau of Statistics, Ministry of Finance and Planning.

Republic of Kenya. 1979. *Report of the Child Nutrition Survey 1978/79.* Nairobi: Central Bureau of Statistics, Ministry of Economic Planning and Development.

Stephenson, L. S., M. C. Latham, and A. Jansen. 1983. *A Comparison of Growth Standards: Similarities Between NCHS, Harvard, Denver and Privileged African Children and Differences with Kenyan Rural Children.* Cornell International Nutrition Monograph Series No. 12. Ithaca, NY: Cornell University.

UNICEF. 1986. *Assisting in Emergencies: A Resource Handbook for UNICEF Field Staff.* New York: United Nations Children's Fund.

UNSO/NHSCP. 1986. *How to Weigh and Measure Children: Assessing the Nutritional Status of Young Children in Household Surveys.* New York: United Nations Statistical Office/National Household Survey Capability Programme.

Waterlow, J. C., R. Buzina, W. Keller, J. M. Lane, and M. Z. Nichaman. 1977. "The Presentation and Use of Height and Weight Data for Comparing the Nutritional Status of Groups of Children Under the Age of 10 Years." *Bulletin of the World Health Organization.* 55(4): 489-498.

WHO/Brazzaville. no date. *Anthropometric Reference Values for Use in the Africa Region.* Brazzaville: World Health Organization, Regional Office for Africa. AFR/NUT/93.

WHO. 1983. *Measuring Changes in Nutritional Status.* Geneva: World Health Organization.

WHO Working Group. 1986. "Use and Interpretation of Anthropometric Indicators of Nutritional Status." *Bulletin of the World Health Organization.* 64(6): 929-941.