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Rural Household Data Collection in Developing Countries:

Designing Instruments and Methods for Collecting Health and Nutrition Data

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CORNELL FOOD AND NUTRITION POLICY PROGRAM

RURAL HOUSEHOLD DATA COLLECTION IN DEVELOPING COUNTRIES: DESIGNING INSTRUMENTS AND METHODS FOR COLLECTING HEALTH AND NUTRITION DATA

Jan W. Low*

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I gratefully acknowledge the useful comments and suggestions received on all drafts of this paper from my collaborators in this series and thank David Pelletier for substantial assistance in reorganizing and clarifying the technical aspects of the anthropometry section. Ken Robinson, Daniel Sisler, Elizabeth Conlisk, and Kathy Kurz also provided editorial comments and suggestions that improved the content of the paper. Whatever knowledge I have in this field derives from my experience with the Malawi Maternal and Child Nutrition Study (MMCN) and my collaboration with MMCN and Cornell staff members. Thanks must also be expressed to those patient participants in the MMCN study who tolerated our seemingly endless questions and measurement sessions.

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ABSTRACT

This paper provides an overview of the most important conceptual and methodological issues that arise when collecting health and nutrition data in developing countries. References for more detailed information are provided as well. The paper focuses on three major types of data frequently collected at the level of the individual household member: anthropometry data; health-related information; and dietary intake data. Experiences about conducting field surveys in Malawi and Indonesia provide additional insights into avoiding common errors in the design and implementation of health and nutrition surveys.

FOREWORD

This paper is one in a series of seven working papers on collecting rural household data in developing countries. Between late 1986 and early 1988, six Ph.D. candidates from Cornell's Department of Agricultural Economics left to do the fieldwork in developing countries for their dissertations. Upon returning to Cornell in 1989, they discovered that they shared common experiences and frustrations while collecting household-level data for analyzing applied economic problems in developing countries. This series of working papers is the result of their collective effort to help other researchers avoid common pitfalls and build upon their experiences.

The working papers provide a practical field guide – for use together or separately – for individuals collecting a wide range of household information in developing countries. Each paper introduces the conceptual and practical difficulties involved in making different types of measurements or collecting different types of information. The guide is intended to provide readers with enough information about various methods so that those best suited to an individual's needs can be selected. Therefore, a variety of methods for collecting data are reviewed and the consequences of choosing one method or another are discussed.

Each working paper is organized into a section on conceptual issues, followed by a section on methods and organization. Conceptual issues address problems that researchers encounter when they move from a discipline's theory to empirical investigation. Often these include defining or measuring dynamic concepts or institutions such as the household, farm unit, time, or the valuation of goods. Related to this is evaluating whether or not to use certain variables in measuring rural lifestyles. In attempting to quantify particular aspects of rural economies, researchers realize that their definitions of selected variables do not always suit the reality of village economies. Thus, the sections on conceptual issues address the need to reconcile the researcher's theory and preconceived ideals with the realities of the survey site.

Although the related literature is reviewed in each working paper, the primary source of information has been the collective research experience of the authors. Examples of field experiences illustrate points made in each working paper. Many items that the authors felt they would have benefited from are included as well.

The target audiences are graduate students and other researchers, academicians, consultants, government employees, members of private voluntary organizations, etc., who are interested in collecting high quality socioeconomic, nutrition, and health data related to rural households in developing countries. In particular, the guide is for individuals who may not have had much prior experience in collecting this type of data, who may not have access to other current written material on data collection methods, or who may have some experience, but may not be aware of recent developments in data collection methodology.

One unique aspect of the series of working papers is its attempt to provide many examples of survey forms that have actually been used in field projects. Each working paper is built around the following question: How can survey forms and record keeping instruments be designed to assist the researcher in collecting high quality, nondistorted, less systematically error-filled data? Frequently, two or more forms that were used in different surveys (or in different rounds of the same survey) are discussed. The author has tried to be frank and honest, frequently providing criticisms of forms or tables that they used, but with which they failed to achieve the intended results.

Finally, a brief word on the use of 'he' and 'she' throughout the collection of working papers. Since the group of authors was equally divided into three men and three women, as a convention, generic third person pronouns and possessives (he, she, him, her) were consistent with the author's gender and should not be interpreted as a violation of political correctness.

The working paper series includes:

Paper Subject	**Series Number**	**Author**	**Author's Country of Study***
Collecting General Household Information Data	91-13	Krishna B. Belbase	Nepal
Collecting Consumption and Expenditure Data	91-14	Carol Levin	Indonesia
Collecting Health and Nutrition Data	91-15	Jan Low	Northern Malawi
Collecting Time Allocation Data	91-16	Julie P. Leones	Philippines
Collecting Farm Production Data	91-17	Scott Rozelle	China
Collecting Off-Farm Income Data	91-18	Leones & Rozelle	Philippines, China
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.

October 1991

Carol Levin and Scott Rozelle
Series Coordinators

1. INTRODUCTION

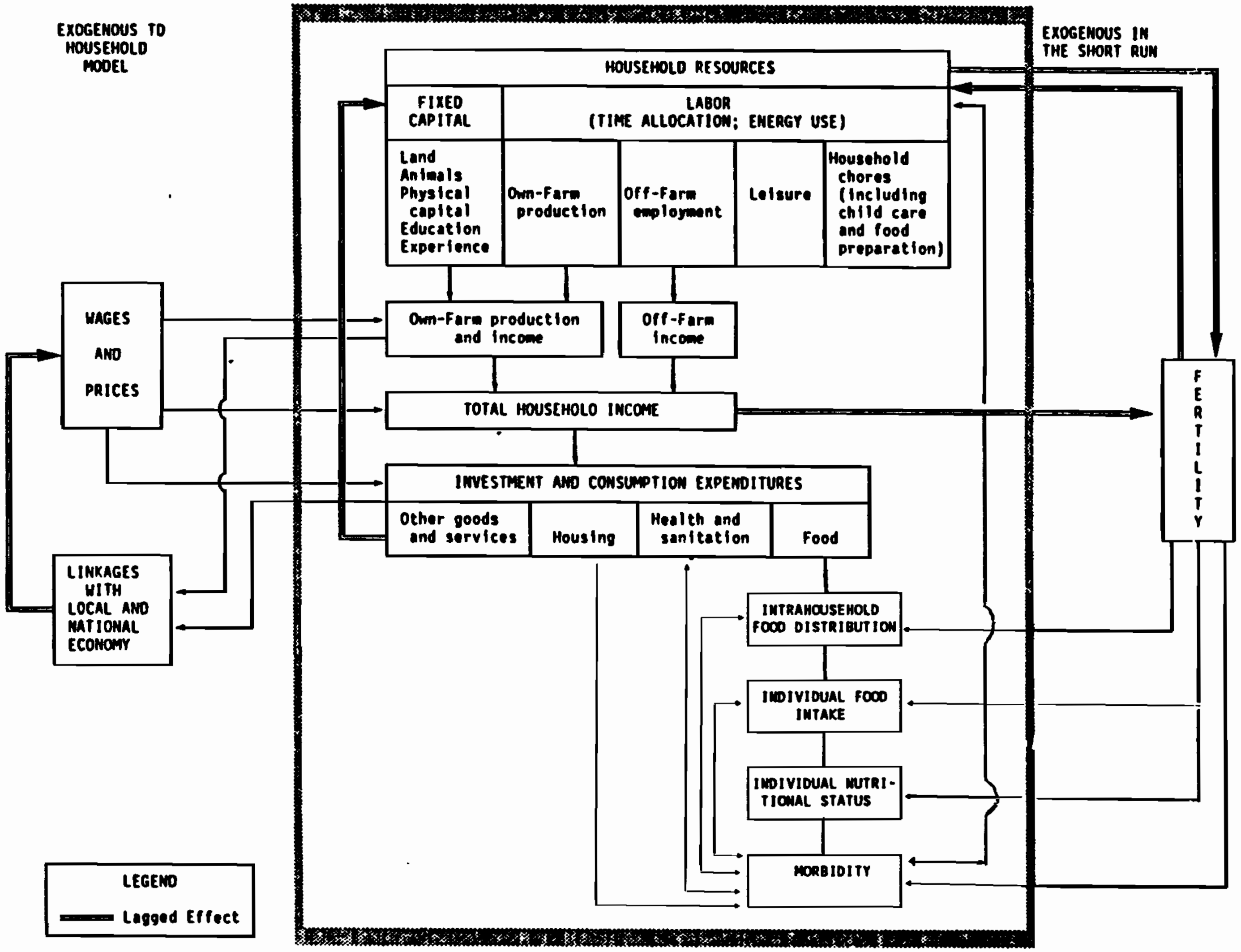
Increasingly, social scientists are incorporating health and nutrition issues into their research agendas as one way of assessing the well-being of a population, often focusing on the vulnerable groups within that population. Anthropologists seek to understand how perceptions of illness influence choice of treatment, and how health and diet affect work patterns and social relations within and outside a household. From an economic standpoint, interventions to improve health and nutrition are envisioned as a means for enhancing worker productivity, which may in turn result in a higher household income. Moreover, assessing the nutritional status of the population provides a basis for evaluating the consequences of programs and policies, such as the promotion of cash cropping or the effects of market liberalization. Considerable effort has also been directed toward identifying the determinants of health and nutritional status, most commonly through the estimation of health production functions or reduced-form demand equations.

Health and nutrition are intimately intertwined. A child who falls ill is often prone to anorexia and has higher nutrient requirements, which can impair nutritional status. Conversely, poorly nourished individuals are more likely to fall ill. Researchers interested in issues about the impact of health status on labor productivity may only be interested in collecting information on "disabling" morbidity (i.e., the interruption of normal activities as a result of illness). However, capturing the full effect of health and nutritional status on productivity requires greater knowledge of the interactions among health, nutrition, and other factors in a given environment.

Nutritional status reflects the state of health of an individual as influenced by the intake and use of nutrients (Gibson 1990). Nutrient intake is just one of several components determining nutritional status. How the body uses ingested food depends on the person's health status (including parasites) and on how genetic endowment conditions that person. In theory, determining nutritional status requires evaluating a combination of clinical, anthropometric, biochemical, and dietary indicators. In practice, most researchers with a socioeconomic focus have neither the resources nor expertise to perform biochemical and clinical assessments. Instead, researchers emphasize obtaining reliable proxies for assessing health and nutritional status, such as recall of the frequency and severity of bouts of morbidity, along with measurements of height and weight to represent the observed state of nutritional status.

Social scientists attempt to integrate health and nutrition into their conceptual frameworks in myriad ways. Economists typically view nutritional status as an important outcome resulting from the allocation of resources at the national, regional, local, and household level. Figure 1 shows an example of how

Figure 1 — Household Resource Allocation and Nutrition/Health



Source: Adapted from Bouis and Haddad (1990).

nutrition and health have been included in a model of resource allocation at the household level.

Clearly, the relationship among the nutritional status, the production system, and the consumption patterns of a household is complex. To understand, for example, the *process* through which nutrition is affected by the allocation of goods produced by a household requires a great deal of knowledge at both the individual and the household level of production, consumption, time allocation, morbidity, and physical growth. For instance, an individual's time allocation pattern and resource base determine the amount of energy used to perform a particular activity. Energy use, food intakes, and morbidity all interact to determine individual nutritional status.

This working paper series focuses on three major types of health and nutrition data frequently collected at the level of the *individual* household member: anthropometry, health-related information, and dietary intake. I will discuss household and community level information only in the context of how and when it may be appropriate to use such information in lieu of collecting detailed individual level data or to capture non-nutrient health-related inputs such as sanitation and water supply.

I have divided each section into a discussion of the conceptual and practical issues related to the various measures. The first section, *Anthropometry*, discusses (a) how to obtain the anthropometric measures of weight, height, arm circumference, and other relevant indicators; and (b) how to derive the validity of the indicators from such measures as proxies for nutritional status. The second section, *Health-Related Information*, focuses on the conceptual and methodological issues related to choosing a recall methodology for collecting data on (a) disease symptoms reported by the respondents ("perceived" morbidity), (b) the interruption of normal activities because of illness ("disabling" morbidity), and (c) the availability and use of health services. The third section, *Dietary Intake at the Individual Level*, concentrates on advantages and disadvantages of different methodologies, emphasizing the need for awareness of different cultural perceptions about what constitutes food.

This working paper does not provide a complete step-by-step guide on how to collect these three types of data because entire books have been written on each of these subjects.[1] Rather it seeks to provide the reader with an overview of

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[1] Researchers unfamiliar with the terminology and techniques used by health and nutrition specialists should obtain Gibson's (1990) *Principles of Nutritional Assessment* for a comprehensive overview of anthropometric and dietary indicators, including reference tables compiled from many different sources. In addition, the World Health Organization's (1983) *Measuring Change in Nutritional Status* (1983) is an essential reference with its straightforward discussion of sampling and standardization procedures, as well as reference data for the weight and height of children. The latter can be ordered directly from the WHO Publications Centre USA, 49 Sheridan Avenue, Albany, NY 12210. Excellent discussions of the (continued...)

the most important conceptual and methodological issues that arise when embarking on health and nutrition data collection. It emphasizes practical insights into designing data collection protocols that will avoid some of the most common errors made when designing and implementing health and nutrition surveys.

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[1] (...continued)
biology and terminology related to human growth are found in Tanner (1978) and in Martorell and Habicht (1986).

2. ANTHROPOMETRY

Among the four categories of nutritional indicators (clinical, anthropometric, biochemical, and dietary), the anthropometric ones are among the least invasive that relatively unskilled personnel can use. Jelliffe (1966) defines nutritional anthropometry as the "measurements of the variations of the physical dimensions and the gross composition of the human body at different age levels and degrees of nutrition." Anthropometric measurements, particularly stature (height or length) and weight, represent the most common tool for assessing nutritional status in societies with significant levels of protein-energy malnutrition (PEM).

Most studies measure only subgroups of the population, typically the "under-fives" (children up to 60 months of age) and/or selected adults in the household. Adolescents are usually not included in general surveys because knowledge of their sexual maturity is necessary for researchers to analyze data in a meaningful way (Tanner 1986).

In many developing countries, clinics may have programs for weighing preschool children, but those programs do not typically measure height, length, or other anthropometric indicators. While body weight can be used as an excellent screening device to detect clinical (i.e., severe) malnutrition, especially in young children, it is a poor indicator of the more moderate levels of PEM that predominate in field studies (Yarbrough et al. 1973). Weight *and* stature are almost always collected in field studies of nutritional status, whether the subjects of interest are under-fives, adults, or both. Weight and height measures have the advantage of being relatively inexpensive to collect, simple to measure, and socially acceptable among most cultures. In under-fives, three common indicators, which can detect chronic (past) as well as acute (present) malnutrition, can be derived from weight and height: height-for-age, weight-for-height, and weight-for-age.[2]

Height-for-age is considered the best index of chronic malnutrition ("stunting"), where the under-five is shorter than one would typically expect for a child of the same age because of the accumulated effect of past bouts of

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[2] These indicators are derived on an individual level. The height and weight of an individual child are compared to those for the same age and sex group in a healthy, well-nourished reference population. The results of this comparison can be expressed as a percentage of the reference median or standardized residuals ("Z-scores"), as explained in Gibson (1990) and Frisancho (1990). Frisancho (1990: 32) also presents a table showing equivalents of percentile and Z-scores in a normal distribution.

morbidity and extended periods of inadequate food intake. Severe, acute malnutrition ("wasting"), where a preschool child is very thin for his or her stature, is best captured by the weight-for-height indicator in children. Weight-for-age captures the effect of both past and present states of malnutrition. Used alone, though, weight-for-age cannot distinguish between (a) under-fives who are low in weight because they are acutely malnourished (wasted) and (b) those who are simply short and thus weigh less.

Researchers often use a combination of indicators to determine whether or not a child's growth is "normal." For example, the well-known Waterlow classification (shown in Figure 2) combines weight-for-height and height-for-age to discern whether a child's growth is normal, stunted, wasted, or both stunted and wasted.

Weight-to-height *ratios*, or body mass indices (BMIs), are the most frequently used indicators for adults. These ratios measure body weight corrected for height, with height often raised to some power. Ideally, the ratio should be highly correlated with weight, as determined through more direct measures, and minimally correlated with height.

Several types of BMI exist.[3] The most popular index in use for nonpregnant adults 20 to 65 years of age is Quetelet's index $(\text{weight/height})^2$ (Gibson 1990: 178). Since these indices cannot determine whether moderately excessive weight is due to excess fat, muscularity, or edema, the index is best considered a measure of relative weight rather than body composition or obesity per se (Revicki and Israel 1986: 992). If the interest is in body composition itself, it is necessary to use other methods such as skinfold thickness or waist-to-hip ratio. Moreover, weight/height ratios are not independent of age (Cronk et al. 1982).

CONCEPTUAL ISSUES

Appropriateness of Anthropometric Indicators as Measures of Nutritional Status

One must always keep in mind that indices derived from anthropometric measurements are only *indicators* of nutritional status. An indicator (e.g., growth in height) not only reflects changes in energy and nutrient intake but also is affected by non-nutritional factors, such as disease, genetics, and diurnal variation.

Some anthropometric indicators are more sensitive than others in reflecting changes in nutritional status. The more severely and more frequently non-

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[3] For a comparison of the relative merits of different indices for adults, consult Lee et al. (1981), Frisancho and Flegel (1982), Garn and Pesick (1982), and Revicki and Israel (1986). Rolland-Cachera et al. (1982) discuss adiposity indices in children.

Figure 2 – Simplified Version of the Waterlow Classification of Child Growth

	Weight-for-Height (Degree of Wasting)	
Height-for-Age (Degree of Stunting)	High	Low
High	Normal Growth	Wasting
Low	Stunting	Stunting and Wasting

Source: Waterlow et al. (1977).

nutritional influences affect an indicator, the less reliable the indicator is as a measure of nutritional status. Failure to realize this leads some investigators to place unrealistic expectations on what an individual indicator can accomplish. Researchers need to specify the purpose for which the indicator is needed. Are the researchers searching for a diagnostic tool to help screen for cases of severe malnutrition or to distinguish among more subtle degrees of moderate or mild malnutrition? Are they seeking an indicator that can identify whether or not the nutritional status of one population subgroup has improved or deteriorated compared to another? Do they need an indicator that accurately predicts undesirable outcomes, mortality, for instance? It is highly unlikely that a single indicator can perform all three functions well.

Thus, the *validity* of an indicator depends on the adequacy with which it represents the nutritional parameter of interest (Gibson 1990: 9).[4] Habicht et al. (1979) cite the example of weight-for-height, an indicator that is frequently claimed to be a sensitive indicator of recent PEM in under-fives. Human biology is such that weight-for-height changes very little in the early stages of protein-energy malnutrition. However, when severe malnutrition begins to set in, there is a sudden, rapid loss of weight. Thus, there is not a clear linearity of response in the weight measure; that is, one does not see the same magnitude of decrease in the nutritional status indicator (weight-for-height) for equal decrements in nutriture. Weight-for-height is, therefore, a very sensitive indicator of recent *severe* PEM, but not of mild to moderate malnutrition. Height-for-age is a far better indicator of mild to moderate malnutrition in developing countries as it reflects the life experience of a child, nutritionally speaking, although it clearly does not reflect recent experiences as well as weight-for-height.

Often researchers are interested in evaluating changes in nutritional status over time. Gibson (1990) notes two drawbacks of nutritional anthropometry for this purpose. First, anthropometric indicators often fail to detect changes over short periods of time. Moreover, used individually, they cannot distinguish between alterations in growth or body composition caused by micronutrient deficiencies and those resulting from inadequate protein or calorie intake. Frequently, it makes sense to combine information from several different measures.

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[4] The literature frequently uses the terms "validity" and "accuracy" interchangeably. Gibson (1990: 10) prefers to restrict the term "accuracy" to describe "the extent to which the measurement is close to the true value" in a statistical sense. "Validity," on the other hand, refers to the extent to which the indicator itself (even if measured with perfect accuracy) reflects the underlying parameter of intent.

Thus, the appropriateness of an anthropometric indicator as a proxy for nutritional status depends on the purpose for which it is to be used and the extent to which non-nutritional factors affect the sensitivity of the indicator.[5]

Comparability of Anthropometric Indicators Across Cultures

Once researchers take anthropometric measurements of an individual, they compare these measures to values for the same age and sex group in the reference population. The researcher can then categorize a child as growing above or below a given percentile of this "healthy population." While it is not possible, particularly in cross-sectional studies, to conclude that the child's size is unhealthy, it can be said that the size deviates from the norm and, as such, carries an elevated risk of adverse outcome.

Researchers who consider collecting anthropometric data often encounter policymakers who are reluctant to accept the legitimacy of comparing distributions of any anthropometric indices from one ethnic/racial background with those from a "healthy" population with a different ethnic or racial heritage (Gibson 1990). Not uncommon are retorts such as: "Of course our children will look malnourished using this approach. You will compare them to American kids, ignoring the fact that we are of different ethnic backgrounds and are shorter by heritage". In response, researchers may decide to abandon the collection of anthropometric data, fearing that policymakers would disregard subsequent results unless they apply locally developed standards – which are generally unavailable.

The issue arises because the World Health Organization (WHO) advocates using the U.S. National Center for Health Statistics (NCHS) growth percentiles as the international reference (WHO 1983). The NCHS percentiles are drawn from a well-designed survey of healthy American children. Their widespread use provides a universal standard for comparing the nutritional status of other populations.

Critics argue that it is more valid to compare a malnourished population within a given country to reference data derived from privileged members of the same ethnic background. The creation of such well-sampled reference populations is prohibitively costly for many countries, however, as evidenced in the assertion by Waterlow et al. (1977) that development of valid reference values requires at least 200 individuals in each sex and age group using one-month age intervals.

Nonetheless, prospective anthropometrists need not throw up their hands in despair. Researchers have demonstrated that the magnitude of difference among well-to-do children from different ethnic backgrounds is not great up to the age of seven, the only exception being children from the Far East (Habicht et al.

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[5] For a thorough discussion of selection criteria for various anthropometric indicators, see Habicht et al. (1979).

1974, Martorell and Habicht 1986). However, the differences within the same ethnic group associated with socioeconomic status are significant. Thus, in many developing countries, the variation attributable to environmental factors far outweighs that attributable to genetics at the population level. As such, the NCHS reference population will suffice for most purposes.

In larger sample surveys of under-fives, researchers can also develop their own *internal* standard for analytical purposes. For example, if for each sex they regress measured height on age (as the "independent" variable), the residual represents the variability in height that is unexplained by the age factor.[6] These residuals, once standardized, can be interpreted like a Z-score. The age effect is removed, allowing comparisons with others within the same study population. A word of caution is in order, however. Researchers should use internal Z-scores only for internal comparisons and analyses, but *not* for estimating the prevalence of PEM in the population because the latter will typically be greatly underestimated, based as it is on the average values in a malnourished population.

METHODOLOGY AND ORGANIZATION

Anthropometric Measurements

Before undertaking a survey, researchers must choose which reference population(s), if any, they will use because these choices will determine the final collection protocol.[7] For example, the stature data for WHO's international growth data were measured as recumbent length for children less than 24 months of age and as stature from 24 months onward (Dibley et al. 1987). To ensure comparability, most studies follow like protocols when measuring stature of under-fives.[8]

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[6] The measured value should first be plotted against age to determine whether the relationship between the anthropometric measure and age is linear or nonlinear. Frequently for children less than two years of age, the relationship is a quadratic curve. In such a case, a quadratic (height = age + age^2) or cubic (height = age + age^2 + age^3) equation should be used. Note also that these equations should be calculated separately for the two sexes.

[7] Dibley et al. (1987) and Frisancho (1990) describe the international growth reference for individuals up to 18 years of age. Gibson (1990) describes other reference data for children and adults.

[8] In infants less than four months of age, obtaining the crown-rump length in lieu of the recumbent length is considered by some to be easier in that it is impossible to completely straighten the legs of young infants. Yet, the reference percentiles most commonly used for deriving the indicators are based on length, not crown-rump. Many studies limit measurement of length to children

(continued...)

Two other measures frequently taken on under-fives are arm circumference (up to five years of age) and head circumference (up to two years of age). Arm circumference-for-age is an indicator of acute malnutrition, whereas head circumference-for-age is indicative of chronic malnutrition during the first two years of life. Less frequent for under-fives, but often recommended for adults, are skinfold measurements to assess body composition. Among these, triceps and subscapular skinfolds are the most common. Each measurement differs in terms of ease of measurement, replicability, quality, and cost of available equipment for executing the task, and acceptability by the respondent. Table 1 summarizes some of these features.

To minimize measurement errors that affect the accuracy and precision of results, researchers have developed standardized procedures. Appendix A contains the summary procedures for child height, length, weight, and arm circumference produced by the United Nations.[9] Descriptions of a host of other anthropometric measurements are provided in Lohman et al. (1988), Cameron (1986), and Frisancho (1990). While most nonspecialists can use published materials to adequately train themselves to measure height, length, weight, arm and head circumference, the incorporation of skinfold measurements into research protocol usually requires the presence of an experienced anthropometrist.

Appendix B provides survey forms to record anthropometric measures taken by the Malawi studies.

Sample Size

Once researchers choose the appropriate anthropometric indicators to be included in the study, they should give special consideration to the accuracy with which each indicator can be measured and to how subtle a difference they want to detect between various subgroups in the study. In general, the larger the sample size, the more precise are the researcher's estimates of the parameters and their differences (Armitage and Berry 1987). Conversely, the more subtle the difference researchers seek to detect, the larger is the required sample size. Yarbrough et al. (1973: 22) provide an excellent example of the latter point when determining sample sizes required to study weight changes across a gradient of PEM.

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[8] (...continued)
above six months of age for this reason. Weight, however, should still be obtained for these young infants.

[9] The preliminary version of this United Nations (1986) manual, *How to Weigh and Measure Children*, contains detailed descriptions of proper procedures for measuring children and standardizing these measurements. In addition, photographs comparing improper to proper techniques make it a particularly valuable resource for field training. It is available in English, French, and Spanish from the U.N. Sales Section; Room DC-2; 853; United Nations; New York, NY 10017; Sales Number 88.IV.2; Telephone: 212-963-2940.

Table 1 – Rating of the Different Indicators by Ability to Fulfill Criteria in Young Children

Criterion	Weight-for-Age	Height-for-Age	Weight-for-Height	Arm Circumference	Head Circumference	Triceps Skinfold	Subscapular Skinfold
1. Population group							
- To serve as an overall indicator of malnutrition	4	2	1	1	2	2	2
- To identify current malnutrition (wasting)	3	1	3	3	1	3	3
- To identify chronic malnutrition (stunting)	2	4	4	3	3	1	1
- To identify a maximum of malnourished children	4	2	2	3	1	2	2
2. Instruments							
- Cost	2	3	1	4	4	1	1
- Portability	3	2	2	4	4	3	3
3. Difficulty in taking measures	3	2	1	3	4	2	1
4. Time to take measure	2	2	1	3	3	2	2
5. Reliability (low error)	3	2	2	3	3	2	2
6. Sensitivity to change over a short time period	4	1	3	3	2	3	3
7. Resistance to measure by families	3	3	3	3	4	2	2
8. Age preference	0-6 yrs., best ≤3 yrs.	0-6 yrs., best >2 yrs.	0-6 yrs., best >2 yrs.	approx. 1-4 yrs.	0-4 yrs., best <2 yrs.	0-6 yrs.	0-6 yrs.
9. Other			age independent	age independent; system adaptable for nonliterate workers		measures body composition; need replicate measures to improve reliability	

Source: For weight, height, and arm circumference, World Federation of Public Health Associations (1985: 13). Otherwise author's assessment.

Notes: Each indicator has been rated on a scale of 0-4: 0 = not appropriate; 1 = poor performance; 2 = moderate performance; 3 = good performance; 4 = excellent performance.

Figure 3 shows the weight deficits for children classified as "clinical PEM" (having been hospitalized with severe malnutrition), "moderate PEM" (currently recuperating from protein-calorie malnutrition), "mild PEM" (group hospitalized for operations or short-term infections), and a group of well-fed children. For the given level of power and significance, only 3 children would be required to detect statistical differences if researchers compare children at the extremes of clinical PEM versus well-fed children. However, to distinguish among those children with mild PEM compared to those with moderate PEM, researchers would need 300 children. In many countries, the seasonal weight deficits that researchers try to detect are generally at this more "subtle" level and require significantly larger sample sizes than otherwise anticipated.

Sampling manuals often advocate constructing "dummy" statistical tables to help the researcher visualize the variables and classification criteria for which data are needed. Each cell in these tables represents a subsample of the population under study having a certain set of characteristics. The number of observations within each cell must be large enough to ensure that inferences concerning the study population can be made with confidence. A generally accepted rule of thumb is that a minimum of 30 individuals should be present in each cell (Edmonston et al. 1985), but as noted above, this number depends entirely on what size of expected difference in the indicator the researcher wants to detect. As the number of factors selected for stratifying the sample grows, so does the sample size.

Clearly, considering the multitude of factors that potentially contribute to malnutrition, researchers must give much thought to the study's primary focus if they are to control study costs. In determining final sample size, they must pay attention to the *power* of the proposed test as well as its significance level. That is, if the researcher assumes a given hypothesis is correct, what sample size is needed to give this hypothesis a chance of being accepted?[10] Kraemer and Thiemann (1987: 52) provide an intelligible description of statistical power analysis as well as tables of sample sizes required at different levels of power, depending on the size of the critical effect and significance level. Throughout their book, they stress that the careful selection of factors to include for stratifying or matching is crucial for cost-effective study design: "Only factors that are absolutely *necessary* to the research question, or that have a *documented* and *strong* relationship to the

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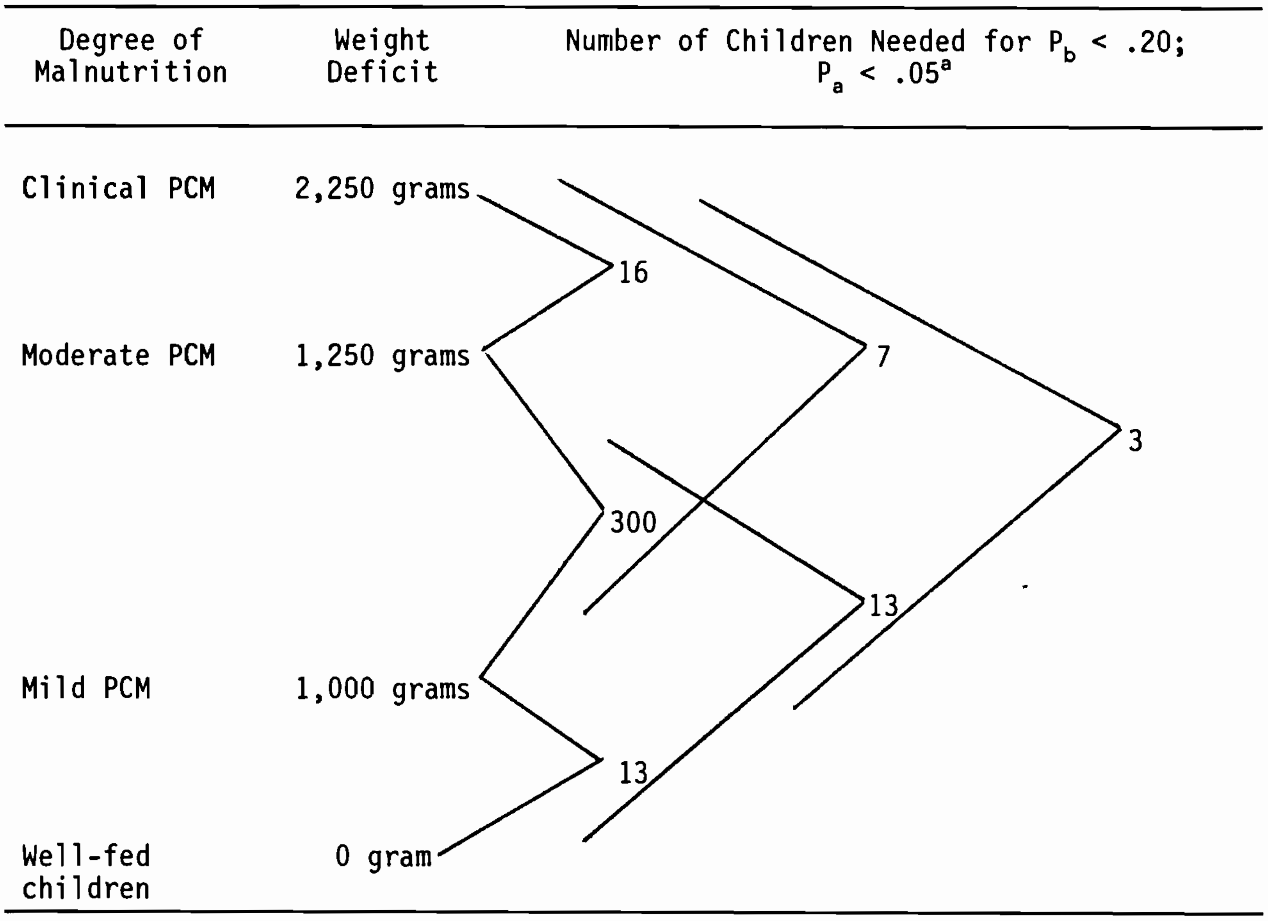
[10] Power and significance are distinct concepts in statistical terminology. In statistical analysis, researchers consider two hypotheses: the null hypothesis and the alternative hypothesis. The null hypothesis generally assumes that the variable under consideration has no effect. If the data lead to the rejection of the null hypothesis, then the alternative hypothesis is accepted. Alpha error is defined as the probability of rejecting the *null* hypothesis when it is in fact true and is given by the level of significance selected by the researcher. The power of the significance test is defined as the probability of accepting the *alternative* hypothesis when it is true. Researchers would like the power of the test to be as large as possible, usually greater than or equal to a probability of 80 percent (Kraemer and Thiemann 1987: 8).

Figure 3 – Severity of Malnutrition, Weight Deficit, and Sample Size (calculations for children of same height)



Source: Yarbrough et al. (1974: 22).

[a] P_a refers to the level of significance and P_b to the power of the statistical test.

[b] PCM = Protein-calorie malnutrition.

response, should be chosen, and these factors should be relatively *independent* of each other (to avoid problems of confounding or collinearity)."

Power is not the only criterion on which to base study design, however. The reduction of sampling error through increased sampling size can result in substantial increases in nonsampling (i.e., measurement) error, particularly when resources are limited. Researchers can minimize nonsampling error by spending adequate amounts of time in preliminary assessment of the research area, by careful designing and pretesting questionnaires, by good initial training of personnel, and by adequately supervising and retraining the staff, when necessary. All these steps become more difficult to accomplish as sample size increases. Edmonston et al. (1985: 12) stress that nonsampling errors are irreparable, whereas sampling errors can be estimated and sometimes incorporated into the analysis. Therefore, they advocate that an appropriate balance be maintained when designing the survey so that reductions in sampling error are not negated by increases in nonsampling error.

The bottom line is that as larger numbers of explanatory factors are included (or as factors chosen are more closely related) in the analysis, the power to detect any effect at all decreases. To compensate for measurement error, the researcher often must substantially increase sample size (Kraemer and Thiemann 1987: 65). However, sample size should not be increased to the point where inadequate resources remain to properly conduct the survey. Edmonston et al. (1985), the World Health Organization (WHO 1983), and the Food and Agriculture Organization of the United Nations (FAO 1990) provide examples of sample size calculations specifically for field surveys of nutritional status. Nevertheless, most researchers will find it necessary at some point during the design phase to consult a statistician. The more familiar the researcher is with the study population and the trade-offs involved in sampling design, the more likely the statistician will be able to make concrete recommendations.

Reliability and Frequency of Collection

When designing the anthropometric component of the survey, researchers must keep in mind three costs as they decide how frequently to collect data: (1) cost per study child, (2) cost per measurement session, and (3) cost per additional measurement during each session. In most instances, cost per additional measurement is the cheapest component, and cost per study child is the most expensive. To achieve the desired power and significance level at least cost, researchers must take into account the variability of each anthropometric measure. Deciding the frequency of collection is thus intimately related to evaluating how much sampling and nonsampling error they are willing to tolerate. Improving reliability of measurement is one major strategy through which researchers reduce nonsampling error.

In practical terms, reliability is concerned with the reproducibility of a measurement over time. Unlike many other types of data we collect, researchers can actually measure the reliability of anthropometric data. Table 2 summarizes the terminology and approach commonly used to assess reliability in field

Table 2 – Practical Reliability Assessment: Structure and Terminology

	Session I: Day 1			Session II: Day 5 to 15
	Enumerator		Supervisor	Enumerator
Subject Age No. (Mos.)	Trial 1 (A)	Trial 2 (B)	Trial 1 (C)	Trial 1 (D)
1	X	X	X	X
2	X	X	X	X
3	X	X	X	X
. . .	...	...	...	...
10	X	X	X	X

$$\underset{\substack{\text{TOTAL VARIANCE}\\ \text{BETWEEN DIFFERENT}\\ \text{SUBJECTS}}}{V_{TOTAL}} = \underset{\substack{\text{INTER-SUBJECT VARIANCE DUE}\\ \text{TO DIFFERENCES IN}\\ \text{UNDERLYING NUTRITIONAL}\\ \text{STATUS}}}{V_{NUTRITION}} + \underset{\substack{\text{WITHIN-SUBJECT VARIANCE DUE}\\ \text{TO ERROR IN MEASUREMENT}}}{V_{ERROR}}$$

$$\underset{\substack{\text{WITHIN-SUBJECT}\\ \text{VARIANCE}}}{V_{ERROR}} = \underbrace{\overbrace{V_{INTER} + V_{INTRA}}^{\text{IMPRECISION}} + \overbrace{V_{DAY\text{-}TO\text{-}DAY}}^{\text{UNDEPENDABILITY}}}_{\text{UNRELIABILITY}} + \overbrace{V_{VALIDITY}}^{\substack{\text{LACK OF}\\ \text{VALIDITY}}}$$

Contrast Measurements[a]	Interpretation:
1. C to A	Imprecision (Inter- + Intra-Observer Error)
2. A to B	Partial Imprecision (Inter-Observer Error Only)
3. C to D	Unreliability (Undependability + Inter- + Intra-Observer Error)
4. A to D	Partial Unreliability (Undependability + Intra-Observer Error)

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[a] Measurements can be compared by calculating the variance. Variance is calculated as:

$$\frac{\Sigma^2 d}{2n}$$

where d is the difference between the two different measurements and n is the number of subjects.

studies. Reliability is calculated from estimates of its respective negative attribute, unreliability.

Typically, when they measure any group of subjects, researchers find considerable variation in the magnitude of the measurement, even for those subjects of the same sex and age range (V_{TOTAL} in Table 2). Researchers should distinguish between variation that is due to differences in the underlying nutritional status of individuals ($V_{NUTRITION}$) and variation that results from overall measurement error (V_{ERROR}). $V_{NUTRITION}$ is what we are really trying to capture for comparing different subjects; V_{ERROR} is what we are trying to minimize.

One component of overall measurement error, $V_{VALIDITY}$, is not typically quantified because it reflects the degree to which the particular indicator actually represents nutritional status, independent of other sources of error. The second component of measurement error is concerned with unreliability. Each anthropometric measurement has its own level of unreliability reflecting its difficulty or ease of measurement.

Unreliability is calculated as:

$$\text{Unreliability} = \text{Imprecision} + \text{Undependability}$$

where *imprecision* is defined as measurement error caused by technique or equipment, and *undependability* is defined as variation that is seen in the *same* subject and that is caused by short-term physiological fluctuations generally beyond the control of the researcher (Habicht et al. 1979).

Estimates of imprecision and total unreliability are relatively easy to obtain. Estimates of undependability are more problematic and must be derived as the differences between the other two measured variables. The major distinction between estimating imprecision and unreliability in a parameter is the *time* separating replicate measurements as described below. Imprecision can be broken down into two components, *intra*-observer error (V_{INTRA}) and *inter*-observer error (V_{INTER}). In a typical standardization procedure, only imprecision is assessed (Trials A, B, and C listed under Session I in Table 2). To obtain *intra*-observer error, replicate measurements are taken within minutes or hours on ten subjects by the same enumerators. Intra-observer error is the variance of the difference between the replicates. Inter-observer error is usually determined by calculating the variance between measurements made that same day by the enumerator and those made by an experienced anthropometrist (e.g., the supervisor in Table 2) on the same subjects, correcting for the enumerator's and supervisor's respective intra-observer error. Inter-observer error is considered to be significantly worse than intra-observer error if it is double or more (Mueller et al. 1988).

To determine unreliability (V_{INTER} + V_{INTRA} + $V_{DAY\text{-}TO\text{-}DAY}$), the repeated measurements are usually separated by enough time so that differences between the two measurements reflect imprecision as described above as well as physiological fluctuations. In other words, sufficient time should elapse for physiological factors (e.g., hydration) to influence the measurement but not enough time for the nutriture to change substantially. Typically, four days to two weeks are allowed to elapse between the measurements (Session II in Table 2). Then undependability ($V_{DAY-TO-DAY}$) is calculated by subtraction. Mueller and Martorell (1988) provide the mathematical formulas needed to complete unreliability calculations and to derive the corresponding positive attributes (dependability, precision, and reliability).

Improving reliability is one major avenue by which researchers can enhance the accuracy of their estimated parameters. First, to decide whether it is worth increasing reliability, researchers need some knowledge of how great that reliability is under a given set of field conditions. Second, if reliability needs to be improved, which component of reliability – precision or dependability – should receive greater consideration? In cross-sectional studies, improving either component of reliability may be less important because gains in reliability may not be offset in cost by reduction in sample size (Habicht et al. 1979). However, in longitudinal studies or studies in which the same cohort is measured several times, researchers need more reliability than in cross-sectional studies because the focus is on changes over time and because the proportion of total variance caused by unreliability is much greater than in the cross-sectional case. It is particularly important to control for imprecision when there is a small time interval between two measurements.

Precision can be improved by increasing the number of measurements taken per session on each individual, adequately training people to reduce measurement and recording errors, strictly adhering to standardized protocols, or improving the instrument itself. Improving dependability is more difficult. Ideally, improving dependability requires taking multiple measurements over some time interval and using the mean of these measurements. However, increasing the frequency of visits to households or the number of measurement sessions in a central location can be very costly. Another common source of undependability are diurnal variations. Daily variations in weight, for instance, occur in both adults (up to 2 kilograms) and children (about 1 kilogram) (Lohman et al. 1988: 8). Whenever possible, researchers should obtain measures of indicators subject to diurnal variation, such as weight and stature, at the same time of day during each measurement session. If that is infeasible, Gibson (1990: 170) recommends recording the time at which the measurement is made. Researchers can use this time measurement to control for diurnal variation in stature and weight during the analysis.

Practically speaking, what does all this mean? The bottom line is this: if, as a researcher, you have decided that anthropometric indicators are worth collecting, then you *must not* ignore reliability. Frequently, however, researchers unfamiliar with anthropometric measurements fail to realize the importance of reliability until their studies are already under way or even completed. Building reliability considerations into the design phase of the study permits minimization of the cost and time needed to implement standardization sessions and any subsequent reliability assessments.

Reliability Assessments: Implementation

Reliability assessments have a dual function: *quality control* during data collection and subsequent *data validation*. The extent and frequency with which various components of the assessment need to be implemented will depend on whether the anthropometric component of the study is a one-shot, cross-sectional survey or whether it includes repeated measurements made on the same cohort of individuals. When researchers collect anthropometric data, they should consider six major points regarding reliability and should incorporate those points into the survey design, if appropriate. I have addressed each point separately.

Protocol Determination Before the Survey Begins (necessary for cross-sectional and longitudinal data collection). The researcher should evaluate reliability *before* beginning the survey so the survey design can take account of it. Ideally, the study would conduct its own assessment on a representative sample of the population on which anthropometric measures would be taken once the survey was under way. Mueller and Martorell (1988) suggest that a sample size of 50 is adequate unless a large number of subgroups are to be measured as well (e.g., infants, pregnant women). In the latter case, larger sample sizes would be required to ensure that each subgroup was adequately represented in the assessment.

Most researchers, however, must make major decisions regarding sample size and the battery of anthropometric indicators to be used before having an opportunity to conduct such an assessment. To do so, they can draw on previously reported values of reliability cited in the literature, such as those reported by Lohman et al. (1988).

An example from a reliability assessment made on 30-month-old children in rural Guatemala demonstrates how researchers used knowledge of an indicator's imprecision and undependability to devise appropriate measurement protocols. On the basis of that assessment, Habicht et al. (1979) calculated the ratio of undependability to unreliability for several anthropometric indicators, as shown in Table 3. A high ratio means the major variability decreasing reliability is undependability. When the ratio is low, imprecision is the main culprit. Clearly with a high ratio of 99 percent, it behooves the researcher to neither waste time taking multiple readings of body weight nor spend limited funds on a more precise scale, because imprecision is an insignificant component of unreliability in this case. Likewise, additional readings per session of head circumference and crown-rump length would not contribute significantly to improving reliability. On the other hand, repeated readings during a session will yield substantial gains in improving reliability of the two skinfold measures, the supine length, and, to a lesser extent, the arm circumference, since imprecision is the major component of unreliability for these measures.

The Northern Malawi study used such values from the literature to determine the number of additional measurements that would be taken at a given measurement session for each indicator. Thus, at each measurement session in the Northern Malawi study, weight, head circumference, and arm circumference were taken only

Table 3 — The Ratio of Undependability to Unreliability of Some Anthropometric Indicators of Protein-Calorie Nutritional Status

Variable Used as Indicator	Ratio
	Percent
Body weight	99
Supine length	34
Crown-rump length	70
Head circumference	82
Mid-arm circumference	44
Triceps skinfold	23
Subscapular skinfold	14

Source: Habicht et al. (1979: 376).

once; supine length was taken twice, and each skinfold measurement was taken six times on each subject. In the latter case, each enumerator on the team took three measurements at each skinfold site and calculated the mean value. The two enumerators then compared their results: if the difference between their respective means exceeded 2 millimeters, they had to repeat the entire exercise. These repeated measurements were an effective way to try to improve the precision and, hence, the reliability of measurements taken in this longitudinal study.

In field studies, it is very difficult to improve dependability. In the Northern Malawi study, researchers took anthropometric measures monthly. It was not deemed feasible or cost-effective to obtain them more frequently. Logistically, it was not possible to measure length or height in under-fives at the same time of day each month. Moreover, when weighing older children and adults, ideally the subject should be nude and the weight taken after the bladder has been emptied and before a meal. Meeting these conditions is virtually impossible in a village setting, particularly if the researcher intends to make repeat visits and wishes to ensure continued cooperation. Instead, researchers can encourage subjects to remove any heavy clothing and can make standard corrections for remaining clothing.

Taking dependable weight measurements for adult women is very difficult. Researchers should note whether the woman is pregnant and, if so, the month of gestation of the pregnancy. Pregnancy is a sensitive topic in many cultures. In Northern Malawi, women were particularly reluctant to reveal they were pregnant until the second trimester. In nonpregnant women, significant weight fluctuations occur because of the menstrual cycle. This additional source of undependability is usually unaccounted for in field studies.

In most instances, steps to improve dependability should be taken only when they do not add substantially to the survey's cost. It is cheaper to record additional information concerning time of measurement and status of the individual, which can be used to control for some undependability sources, than to conduct additional measurement sessions.

Researchers should consider one other major issue when designing the anthropometric data collection protocol. Ideally, in cross-sectional studies, enumerators should be rotated among clusters to minimize any bias caused by individual examiners (Gibson 1990: 159). In contrast, in a longitudinal study, the same enumerator should carry out all sequential measurements on the same group of subjects to eliminate inter-observer error. Implementing such procedures, however, may prove to be impossible. Rotating enumerators in cross-sectional surveys requires additional transport, time, and cost considerations. The longer the duration of a longitudinal study, the greater is the likelihood of staff turnover. Thus, to control for such bias, researchers must record the identity of the individual enumerators during data collection and must implement the appropriate standardization and supervision protocols.

Initial Standardization of Enumerators in a Group Session (necessary for cross-sectional and longitudinal data collection). Annex I of the WHO manual (1983)[11] provides a step-by-step guide to the standardization procedures used to determine imprecision (as outlined under Session I in Table 2). The standardization procedures based on repeated measurement of 10 subjects are usually conducted toward the end of the training period so as to evaluate the precision of the anthropometric team.

While the actual standardization procedure may take only a half-day to complete once all the subjects and enumerators are present, it usually takes a full-day because of the difficulties in getting 10 subjects and the enumerators in the same place at the same time. Both the Northern Malawi and the Indonesia studies conducted standardization sessions in clinic settings. The process is very time-consuming and fatiguing for participants. Moreover, it may be the first time for many children to be exposed to some of the equipment, such as length boards. In such instances, it is useful to have one or two extra subjects included in case a child becomes too frightened or someone has to leave during the procedure. Giving candies or small gifts to older children may be appropriate in this instance to encourage their cooperation.

Undertaking standardization procedures in the Northern Malawi study revealed the weaknesses and strengths of each particular measure. Head circumference and weight of under-fives were the most straightforward and replicable measures obtained by enumerators. When enumerators misread values off the tape on the length board, they introduced considerable error. In this instance, additional training and cross-checking of the recorded value on the final form were the most appropriate approaches to improve precision.

Ongoing Field Supervision (essential for cross-sectional and longitudinal data collection). Once out in the field, field supervisors should consistently monitor the anthropometric skill of the enumerators, correcting poor technique whenever necessary. A check list used by supervisors to monitor anthropometric techniques in the Northern Malawi study is provided at the end of Appendix B. In general, the weaker the ongoing system of field supervision, the more important it is to increase the number of measurements per session.

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[11] The terminology used in the WHO (1983) manual can be confusing. The WHO manual uses the terms "inter-observer error" and "inaccuracy" interchangeably. In WHO's approach, inaccuracy can be viewed as systematic bias, the extent to which measurements depart from the "true" value. This departure is based on the assumption that the experienced anthropometrist against which other staff members are being compared is always obtaining an accurate measure, thereby acting as a "gold standard." Elsewhere in the literature, "accuracy" is defined as the extent to which an indicator truly reflects nutritional status, independent of other sources of error (what Gibson [1990] refers to as validity). This component of reliability is not quantifiable in absolute terms and is usually ignored when assessing reliability in the field. To avoid confusion, I will use the term "inter-observer error" in this section.

Initial Standardization Session for any New Enumerators (necessary for cross-sectional and longitudinal data collection). The same training and standardization procedures should be applied to any replacement enumerators. The supervisor can apply these procedures on an individual basis. Given the time frame of most cross-sectional surveys, researchers should consider training a number of backup enumerators at the same time as the original team even if they are not then hired for the survey. Paying these extra enumerators to attend the training is a very worthwhile investment; if any replacement enumerators are needed during the survey, the researcher can directly hire from this pool of pre-trained candidates.

Subsequent Standardization of Enumerators in Group Sessions (not necessary for one-shot, cross-sectional surveys; optional for longitudinal surveys). Bringing enumerators to a central location to repeat the standardization procedure is not necessary for longitudinal surveys that collect anthropometric data on a regular basis *if* there has been good ongoing supervision in the field. However, in most socioeconomic studies with an anthropometric component, measurements are not taken on a monthly basis, but rather at specified times during the year when researchers expect significant contrasts in magnitude. Given the lapse of time between rounds, it is recommended that the enumerators are re-standardized before to each round.

In the Indonesia study, conducting re-standardization sessions while the field survey was in progress proved to be costly and hard to manage. Transportation and lodging had to be provided for enumerators brought in from the field, difficulties were encountered when they tried to find 10 subjects of the right age and sex, and the atmosphere in general was rather chaotic during the entire process. Given the delay in getting under way, only the first round of the procedure was completed by noon. Because the participants were provided lunch as an incentive to participate, it was not surprising to find that some had gained up to 0.5 kilograms during the second round of measurements.

Spot Checks for Data Validation and Quality Control (optional, but highly recommended for cross-sectional and longitudinal data collection). The timely collection of reliability data throughout the course of a study is a very useful quality control measure (Mueller and Martorell 1988: 86). Researchers can use results from such procedures immediately to modify and improve measurement protocol. Moreover, researchers should conduct their own reliability assessment so that they can report their total error variance and use it to help interpret study results. Spot checks made by field supervisors during the course of a survey are a cost-effective way to collect reliability data. Researchers are striving to obtain a point estimate of unreliability (imprecision plus undependability) over the course of the survey period. To obtain this estimate, the supervisor should remeasure a fixed absolute number (50 to 100 should be adequate) from each subgroup of interest (e.g., under-fives, pregnant women, etc.). The remeasurements should be evenly distributed across time and space; that is, the same number of participants from each subgroup should be remeasured in each season and each cluster. Table 4 provides a sample outline for collecting information for under-fives in 10 study clusters where a total of 5

Table 4 – Ongoing Reliability Assessment in the Field

Month: _____ Year: _____ Round No.: _____
Type of Measurement: __________
Subgroup of Interest: Under-fives

				Session I: Day 1			Session II: Day 8		
				Enumerator			Supervisor		
Study Cluster No.	Subject No.	ID No. of Subject	ID No. of Equipment	ID No.	Measurement (C)	Date Taken	ID No.	Measurement (D)	Date Taken
1	1								
	2								
2	1								
	2								
3	1								
	2								
4	1								
	2								
5	1								
	2								
:	:								
10	1								
	2								

Contrast Measurement:	Interpretation:
C to D	Unreliability (Undependability + Inter- + Intra-Observed Error)

rounds of anthropometric data were being collected. If 100 under-fives were desired for the reliability assessment, the field supervisor would have to remeasure only two children per cluster during each round. The supervisor would return to a household four to seven days after the enumerator initially measured the under-five. The supervisor's remeasurement provides the missing link for determining unreliability, or total measurement error variance.

Undertaking reliability assessment while the data are being gathered strengthens ongoing supervision and provides a valuable analytical tool. Knowing the total measurement error can be particularly useful when an hypothesized relationship between an anthropometric indicator and the variable of interest fails to materialize. If unreliability is high, it increases the possibility that the nonsignificant result is due largely to measurement error. If low, the researcher can conclude with greater certainty that indeed no relationship exists.

Table 5 summarizes the steps for improving the reliability of anthropometric measures discussed in this section.

PROBLEMS ENCOUNTERED

Determining Age

In populations where dates of birth often go unrecorded, incorrect age determination can be *the* single most important source of error when deriving an under-five's weight-for-age or height-for-age. For example, a boy who is 2 years and 7 months old and is 91.0 centimeters in height receives a Z-score of 0, equivalent to the median reference standard. However, if the boy's age is rounded up to 3 years, his Z-score drops to -1, and he is classified as mildly stunted. This tendency to round ages toward year or half-year intervals is called age "heaping" and can be detected during the data collection process by constructing a frequency distribution of the children's ages as data are gathered. If births are evenly distributed throughout the year, roughly 8.3 percent of the children should be born in a given month each year. If this percentage is not the case, age rounding may have occurred. Not all age "heaping" is artificial, however; some natural age heaping may reflect seasonal birth patterns. For example, a common pattern in unimodal agricultural cycles is for conceptions to peak at the beginning of the growing season when households reunite for land preparation and planting. Health personnel are often aware of these natural peaks, and researchers should explore this possibility during the presurvey investigation.

If researchers anticipate difficulties in determining the age of children, then instead of asking the mother to report the age of the child, they can use a two-stage process: (1) identify the year of birth, and (2) identify the month within the birth year. Fortunately, exact age determination in adults is not as critical as in under-fives. The nutritional status of adults is usually evaluated using weight-for-height, skinfold measurements, or changes in

Table 5 — Sources of and Strategies for Combating Unreliability in Anthropometric Measurements

Type of Measurement(s)	Major Source of Error	Ideal Strategies	Second Best Solutions
Weight, head circumference, crown-rump length	Undependability	• Increasing the number of measurement sessions and using the mean of measurements taken over some time interval (e.g., one week).	• Conducting ongoing reliability "spot checks" during the survey period.
Weight	Undependability	• Measure subjects at the same time of day.	• Record time of measurement.
		• Measure subjects nude.	• Have subjects remove all heavy clothing; make standard corrections for remaining clothes.
		• For pregnant women, record month of gestation.	
		• For nonpregnant women, record date of most recent menstrual cycle.	
Supine length, height, skinfolds, arm circumference	Imprecision	• Additional measurements per person.	• High quality equipment that can be read without difficulty.
		• Adequate training to reduce measurement and recording errors.	
		• Use of precise equipment.	• Frequent calibration of equipment.
		• Multiple standardization sessions throughout the survey period.	• Single standardization session during training with adequate field supervision.
All	Systematic bias	• **Cross-sectional surveys:** Rotating enumerators among all study clusters.	• Adequate training and standardization procedures.
		• **Longitudinal surveys:** Same enumerators measure same subjects throughout the entire survey.	• Recording identification numbers of enumerators and their equipment.
		• Standardization sessions in which the enumerators are compared to an experienced anthropometrist.	• Standardized protocols are followed in the field.

indicators over time. These indicators are less age-dependent than height-for-age or weight-for-age.

A national or regional calendar of events is commonly used to help pinpoint the year of birth for adults as well as children. Such calendars of events can frequently be obtained from National Statistics offices. In the Northern Malawi study, most people were aware of only a few limited national events, and it was necessary to supplement the calendar with more locally specific events. Because adults are frequently grouped in 5-year age categories for analysis, precision in obtaining exact age is somewhat irrelevant.

The agricultural calendar proved to be the most useful tool in the Northern Malawi study for determining the month of a child's birth. Researchers can supplement this information by noting other important nonagricultural events that occur during the year – major holidays, time when taxes and school fees are paid, and other significant local events that may be month specific.

Another potential source of age data is the national identity or growth clinic card. Researchers should be aware that the accuracy of such recorded age data may be dubious. In Indonesia, birth dates were recorded for all individuals on their national identity card. This date was recorded during the enumerator's first visit. In each subsequent month, however, enumerators would confirm the recorded age with what each individual reported to be his or her age. They often found that ages changed, especially for children over five and adults. In contrast, the birth dates recorded on clinic growth cards for preschoolers proved to be fairly accurate. Mothers retained those cards in good condition, even for older preschoolers.

Clinic cards are not necessarily reliable sources of birth date information in other settings. In the Northern Malawi study, mothers who had not given birth at clinics often had the date of birth recorded during their first clinic visit. In many cases, this first visit occurred several months after the child's birth. Moreover, cards for older children were often lost and replaced with a duplicate when the child was brought for treatment. Duplicates frequently had the birth date recorded as it was recalled by the mother at the time of the visit.

One approach to minimizing the age heaping problem is to obtain several estimates of the month and year of the same child's birth and then either average or subjectively evaluate the reported figures. In the Southern Malawi study, estimates of birth year and month for under-fives and birth year for adults were obtained during each of three rounds of anthropometric measures. Researchers compared the three reported birth dates and derived a more informed estimate than was possible by using a single reported birth date.

Equipment

Given the cost and effort involved in collecting anthropometric measures, it seems ludicrous to skimp on the quality of equipment used. In field work, however, researchers must balance several factors when selecting equipment to order or to have locally made. They should consider precision and cost, alongside portability and especially durability. They should provide for training the staff in proper maintenance and, whenever possible, for having a qualified staff member who can make basic repairs and adjustments. In large-scale studies, each supervisor should ideally have access to calibration standards for each piece of equipment. Equipment should be examined at least once a month for damage and standardization. Both Gibson (1990) and Lohman et al. (1988) list addresses of equipment manufacturers. The United Nations (1986) handbook contains guidelines for standardization of scales, height/length boards, and arm-circumference tapes. It also provides detailed drawings for a portable height/length board that local carpenters can construct. Many researchers prefer to have length boards and/or height poles constructed locally because purchased versions can cost more than US$ 200. Moreover, local manufacture provides indigenous carpenters with income. In the Northern Malawi study, however, the local construction of portable length boards and height poles required much supervisory time, and delays were incurred because local carpenters had difficulty obtaining materials and achieving the degree of precision required. Therefore, researchers should carefully consider the relative benefits of having equipment constructed locally. Obviously, conditions vary from country to country, and between urban and rural areas. For longitudinal studies, it is recommended that 1 additional board be constructed for each five made, to replace damaged equipment if that equipment is heavily used (i.e., on a daily basis). Each piece of equipment should be given a separate identification number to ease subsequent application of correction factors found during monthly calibrations.

Many studies may be tempted to measure standing height using the microtoise, which has a head-bar attached to a coiled tape measure that can be secured to a suitable vertical surface. The microtoise is attractive because it is light, easy to carry, and relatively inexpensive. Our experience has shown that the microtoise should be avoided, however. The Indonesia study initially used microtoises in its rural household survey. Frequently, there was no place to properly hang the instruments because households either did not have high enough walls, or the walls were not constructed of adequately solid material. The final hanging place was often a nearby tree on uneven ground. Moreover, after four months in the field, all the microtoises were broken. At that point local carpenters were hired to construct dual height/length boards.

For weighing under-fives, the Salter hanging scale that reads up to 25 kilograms (with 100-gram gradations) is reliable and durable. Shorr (1989) highly recommends the scale produced by CMS Weighing Equipment. Experience with portable scales for weighing adults was exasperating in the Northern Malawi study. Conveniently sized UNICEF bathroom scales were unreliable and quickly replaced. The German-produced SECA scales were more durable, but as with many spring scales, needed frequent repair. Placement of the scale on a flat surface is essential for consistent readings. Tilting the scale altered a subject's weight by as much as one pound. Enumerators were provided with a board to place under the scales to facilitate leveling, and they were provided with a padded carrier bag. Each team used a large rock of known weight to standardize the scale each day. Enumerators found the dial of the scale difficult to read. Researchers should consider digital read-out scales for weighing adults, although this type introduces the additional burden of replacing battery cells. Clearly, there is an urgent need for a reliable, durable, portable, easy-to-read scale for weighing adults.

In contrast, a different kind of problem emerged when both adults and under-fives were being weighed in the Indonesia study. In this case, the bathroom scale intended for adults was lighter and less cumbersome to set up than the under-five hanging scale. Enumerators often tried to avoid having to carry the under-five scale to the field by first weighing the mother on the bathroom scale alone, then weighing her with her baby. This unacceptable situation was remedied only by heavy supervision to ensure that the under-five scale was always carried to the field.

Experience in Malawi with skinfold calipers suggests that the Slim Guide calipers (Ann Arbor, Michigan) perform adequately and cost much less than the better-known precision Lange calipers.[12] The low-cost McGaw skinfold calipers, however, are too imprecise and should be avoided. Precision calipers need to be recalibrated regularly with calibration blocks. Insertion circumference tapes produced by Ross Laboratories (Columbus, Ohio) for mid-upper arm and head-circumference measurements are simple to use and easy to read. However, if not properly handled, the tapes are easily damaged and the scales become worn. Tapes may need to be replaced every six to nine months.

There is no doubt that anthropometric equipment that is continually moved from village to village or from house to house during field studies is going to have a shorter life span than equipment placed in a clinic or other permanent location. Care during transport and use can greatly increase longevity of sensitive devices. Supervisors can adopt various strategies to encourage proper use of equipment. During training, supervisors should stress proper care and standardization of equipment. Spot checks of equipment in the Northern Malawi study demonstrated that bonuses for field staff on the basis of equipment care will help to minimize errors attributable to faulty measuring devices. In Indonesia, the researchers found locations closer to clusters of study households for storing the length/height boards and under-five scales. The Indonesia study also faced the additional problem of enumerators frequently "forgetting" to carry the equipment because they often had to travel long distances to households. The study decided to provide pocket money so enumerators could pay younger children to tote the equipment.

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[12] Some systematic differences did exist between the two calipers when compared in Northern Malawi. For triceps skinfolds, the Slim Guide consistently measured 0.5 millimeters over the Lange at low readings (around 4.0 millimeters) and 0.5 millimeter under the Lange at higher readings (12.0 millimeters) (Pelletier et al. 1991). The only other problem encountered with the Slim Guide was that the needle rubbed against the scale with some calipers, leading to difficulties in reading some of the marks. The manufacturer suggests that users bend the needle up slightly to avoid the scraping problem.

Cultural Considerations

In any field setting, researchers should conduct a presurvey investigation to determine what actions the community might consider invasive; what fears may be present regarding health workers (enumerators conducting nutrition and/or health surveys are inevitably considered to be health workers); and any special considerations needed because of gender, age, or religion. Scrimshaw and Hurtado (1987) describe anthropological methods useful for interviewing key informants in small groups, as well as sample questions pertaining to nutrition and health care procedures. Such background information is essential for designing culturally sensitive procedures for data collection.

Introductory meetings with village leaders and the community at large are crucial, not only to acquaint participants with the purpose of the study, but also to demonstrate the anthropometric measurements to be taken. Staff members must be thoroughly familiar with the purpose of each measurement so they can adequately answer any questions from the community.

Even then, rumors or false information can jeopardize the study. For example, in Northern Malawi we discovered villagers believed arm circumference and triceps skinfold were taken to assess how much blood an individual possessed and that those individuals with sufficient blood were earmarked for having their blood stolen during the night. Such rumors persisted well into the second year of the study. Meanwhile, in Southern Malawi, the mark left by using a Bic pen to mark the mid-arm point where skinfold was to be measured was rumored to be an injection of AIDS.

Dealing with fears of anthropometric measurements, in particular, calls for creativity in designing equipment. In many parts of Africa, for example, measurement of young children when they are lying down is associated with measurements taken to build a coffin for a deceased child. This image is reinforced when the infant length board is an open box and thus *looks like* a coffin. Anticipating this problem, the Southern Malawi study used flat measuring boards instead of the box type and decorated the board with bright colors and stickers to downplay as much as possible the coffin association.

No matter what attempts are made to alleviate fear, inevitably the enumerator will encounter crying infants and frightened children who will vigorously resist being stuffed into a piece of cloth dangling from a scale or being held down on hard, flat boards. In general, the enumerator's strategy should be to get the process over as quickly as possible. Children are unlikely to be more cooperative if enumerators postpone measurement until later. The Northern Malawi study did find it useful to place the principal care giver as close to the frightened child as possible while taking measurements and to prevent other children from making fun of the frightened child.

Researchers cannot always predict the reactions of communities to gender differences. Women employees are preferred in most studies where birth weight and gestational age are to be assessed. But in Northern Malawi, we found that both male or female enumerators were acceptable for obtaining anthropometric measurements on study participants, regardless of their gender. The success of using the paired male and female enumerator teams in obtaining data from women may be because they were widely viewed as health workers, in spite of explanations to the contrary.

In general, invasive techniques (e.g., anthropometric measurements requiring blouses or skirts to be removed) should be avoided at the village level. Researchers need to be aware that participants may not openly display displeasure. For instance, an apparently cooperative household member during the initial visit may be mysteriously absent during subsequent visits. A team approach does allow some privacy during the measurement or interview process if this is an important consideration. One enumerator can interview a household member off to the side, while the other deals with the larger group. In this manner, the female enumerator was able to discuss issues such as pregnancy without other members of the household being present. In Malawi, as in many other African countries, it is considered bad manners to comment on pregnancy or to openly ask when the child is expected. To overcome reluctance to admitting pregnancy, enumerators gave blankets to babies who were born to study participants. However, the decision to give something or to provide a service to participants must be made carefully and may require prior consultation with government officials. In Malawi, for example, authorities were reluctant to authorize any intervention that could possibly interfere with services provided by government clinics or with expectations from future surveys.

Ethics of Intervention in Life-Threatening Situations

Most studies develop policies concerning how enumerators should interact with members of the community. For instance, in Northern Malawi enumerators were not allowed to lend or borrow money from study participants and were reimbursed for a stipulated amount of money those enumerators contributed when attending the funeral of any member of the study village. Collection of health-related data, though, has the extra problem that enumerators may possibly identify life-threatening situations where no action is being taken or participants may request intervention by the survey staff. Researchers need to decide whether or not to intervene – either with advice, transportation, or treatment – when they encounter life-threatening situations. Determining under what conditions such intervention should occur depends on the characteristics of each study area (cultural taboos, expected behavior, legal restrictions); the expertise of the staff; and the resources available to the project. Again, researchers should discuss this issue in the planning stages of the study to avoid delay and unexpected costs when the situation actually arises.

Types of Information to Collect as Control Variables

When collecting anthropometric data on under-fives, in addition to the age and sex of the child, several other bits of information are often needed to help explain growth patterns. Researchers can group such information, often referred to as "control" variables, under five headings: (1) individual, (2) parental,

(3) household, (4) community, and (5) environmental characteristics. Examples shown in Figure 4 for each category are commonly recorded in analyses when nutritional outcomes are of particular interest. The list, however, is not all inclusive, nor is it necessary in every study to collect data on all the variables shown. Moreover, some variables may be highly correlated (e.g., mother's age and parity) and thus unsuitable for concurrent use in a regression equation.

In this section, we discuss only the methods used and problems encountered in collecting the individual- and parental-level variables. In other working papers in this series, we will describe collection of much of the information described under the household, community, and environment categories. Again, we cannot overemphasize that the choice of variables depends on the purpose of the study and available resources.

Individual Level. In clinical settings, *birth weight* is commonly measured soon after delivery. Ideally, the child is placed nude in the center of the pan of a pediatric scale to evenly distribute the child's weight. Researchers relying on clinic data should verify that the scales used by the maternity unit are properly calibrated and that all staff working in the unit can use the equipment properly. Experience in Northern Malawi suggests that scales in public health facilities participating in the survey frequently need to be replaced with higher-quality equipment to ensure accuracy of measurement.

In the case of home births, enumerators should make every effort to weigh the child within 24 hours after birth. Because newborns commonly lose weight during the first few days after birth, it is important to record the time of the actual measurement.[13] In Northern Malawi, enumerators had to pay particular attention to preventing the newborn from becoming chilled because the home setting was rarely warm enough for a nude infant. To minimize body exposure, enumerators carried small blankets and weighed infants in a cloth bag with straps. While the hand-held midwifery scale was easily transported to the field, the markings on the bar were extremely difficult to read. Enumerators had to verify the reading, which significantly lengthened the duration of the measurement. Accurate hand-held scales with digital readouts, if they exist, would be far superior.

Enumerators can also obtain *recumbent length* or *crown-rump length* at birth. The latter measurement is often preferred because it is impossible to completely

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[13] In developed countries, weight losses of up to 10 percent of the initial birth weight can occur. In Northern Malawi, a subsample of newborns was weighed at birth and at regular intervals thereafter for a period of seven days. The results provided a means for adjusting birth weights obtained in the home more than 24 hours after the actual birth. Fortunately, in the subsample, weight losses as high as 10 percent did *not* occur during the first few days after birth, a common observation in populations with widespread chronic malnutrition (Offringa and Boersma 1987: 307).

Figure 4 — Categories of Control Variables

1. <u>Individual</u>

   - Age
   - Sex
   - Birth weight/length
   - Gestational age
   - Birth spacing
   - Birth order
   - Number of older/younger siblings
   - Weaning:
     - Age of introduction of non-breast milk food
     - Age of complete cessation of breast-feeding

2. <u>Parental</u>

   - Education
   - Nutritional knowledge
   - Age of parents
   - Parity of mother
   - Height of parents
   - Occupation

3. <u>Household</u>

   - Size
   - Ratio of dependents to adults
   - Land area cultivated or owned
   - Total assets
   - Nonlabor income
   - Location — e.g., rural vs. urban
   - Gender of household head

4. <u>Community</u>

   - Distance to health centers and/or schooling facilities
   - Cost of using health centers and/or schooling facilities
   - Congestion of facilities
   - Prevalence of major health problems
   - Prices of food and nonfood items
   - Wages

5. <u>Environmental</u>

   - Distance and quality of drinking water
   - Quantity of water used/available
   - Sanitary facilities
   - Rainfall
   - Altitude

straighten the legs of a full-term newborn, and yet appropriate reference data and cross-study comparisons are generally lacking. Length boards should have a long groove down the center or sides for the movable piece so that enumerators can easily measure shorter crown-rumps as well as the usual recumbent length. Given the delicate nature of the newborn's head and neck, enumerators should be especially careful when placing the infant on the board. Lohman et al. (1988: 13) contains a description of the crown-rump measurement technique.

For field studies, the most common method used to determine *gestational age* is to ask the mother to recall the date of her last menstrual period before pregnancy and then calculate the number of weeks elapsed from that date until the termination of the pregnancy. Unless this date is documented early in pregnancy, the accuracy of this information is highly suspect. Ideally, researchers would perform a clinical evaluation of the maturity of the infant at birth, such as the Dubowitz assessment (Dubowitz et al. 1970). The assessment is done during the first week of the infant's life, but not during the first 24 hours after birth. Several shorter versions of the original Dubowitz assessment that can be used. Extensive training is required, however, usually in coordination with medical personnel. For this reason, the assessment of gestational age is beyond the scope of most studies. Unfortunately, in many developing countries, the fall-back data – hospital records – seldom have accurate information on gestational age.

Birth order and *birth spacing* can be tricky to collect when the respondent is unsure of each child's birth date. By definition, birth order should be the child's rank among all the offspring, whether living or dead, of his or her mother. Miscarriages are usually not included when determining the child's rank. Researchers should indicate whether their calculations of birth order account for stillborn births. Researchers must also use sensitivity when asking questions concerning deceased children. In Malawi, it was considered tactful to refer to deceased children as "those who are no longer with us." An effective way to obtain birth order for all children in the household is through construction of family trees, using distinctive symbols to indicate deceased children. Appendix C shows a diagram demonstrating family relationships in a small household.

Alternatively, researchers can derive birth order by recording the number of older living siblings and the number of older deceased siblings of each individual included in the sample. This approach is particularly suitable when the researcher is interested in the birth order of a "focus" child as opposed to all the children in a particular household.

Birth spacing can be derived from dates of birth or estimated ages recorded elsewhere for living children. When information on birth order and birth spacing is desired for all children, the best approach is to list the outcome of each pregnancy from oldest to youngest, noting the child's name, sex, and estimated birth date.

Weaning is a process that can last anywhere from 6 to 24 months, beginning with the first introduction of nonbreast milk food to complete cessation of breast-feeding. Researchers should specifically define which aspects of this process are of interest. For instance, those interested in exposure to disease pathogens may want to collect the age at which the first purgative or nonbreast milk liquid or food is introduced to the child. Other useful markers of stages in the weaning process are the age of introduction of "adult" foods, and the age at which a child completely stops breast-feeding. The latter variable is easier to collect in societies where children are weaned abruptly than in societies where children are gradually weaned. Children in Malawi, for example, are often completely weaned as soon as the woman becomes pregnant again. Researchers interested in child-feeding practices may also want to collect more detailed information on the types of supplementary feeds given, frequency of feedings, breast-feeding patterns, etc.

Parental Level. Relevant parental-level variables, including age, education, and occupation, are often collected as part of the baseline survey. Increasingly, researchers collect information on both parents for the measured under-five. To avoid missing values for characteristics of parents who are absent or deceased (i.e., those not usually included on the baseline questionnaire), researchers can record parental information in a space on the same form with the child's anthropometric measurements.

When children do not live with their biological parents, researchers must decide whether substituting the principal care giver's characteristics for the parents is justified. The decision essentially revolves around whether the researchers need data about the physical or genetic influence of the parents (e.g., mother's height), or about the environmental element of parental care (e.g., care giver's nutritional knowledge).

Formal education is often viewed as a proxy variable for a care giver's nutritional knowledge. However, supplementary questionnaires should be administered in most cases to ascertain the extent of a person's knowledge of the properties of different foods. There are two distinct approaches. The most common is to evaluate how well-versed the person is in nutrition and other health-related messages promoted by existing programs. With this approach, it may be possible to assign an overall score based on how well the respondent's answers coincide with the material to which they have been exposed. Alternatively, more extensive presurvey work can be done on local foods, traditional feeding and health practices, and interviews designed to assess to what extent the person's knowledge of properties of different foods in the household resulted in health-promoting behaviors. In the Northern Malawi study, researchers adopted the first approach. Appendix D shows a sample questionnaire.

Parity is defined as the "number of previous pregnancies terminating in delivery" (Mata 1978: 98). Pregnancies ending at less than 20 weeks gestation are either miscarriages or abortions. Deliveries occurring at 20 weeks or longer gestation are either liveborn or stillborn infants. Collection of this information is similar to that for birth order.

Finally, the *height of the parents*, particularly the mother, is often included as a proxy for unobserved genetic effects and/or unobserved family background variables, particularly in countries where poverty is viewed as intergenerational. Indicators involving the weight of the mother are more difficult to use as control variables because nonpregnant women cannot be compared to pregnant women; even in nonpregnant women, weight is not perfectly correlated with height.

3. HEALTH-RELATED INFORMATION

To date, most health interview surveys have been conducted to assess any one or various combinations of five factors: (1) knowledge of peoples' perceived morbidity, (2) the impact of recent morbidity on nutritional status, (3) disruption of normal working patterns because of illness, (4) use of different kinds of health facilities, and (5) perceived need for health services within a community. As social scientists have become increasingly interested in the complex interactions between health and time use of different household members, those scientists have incorporated morbidity and health care components into socioeconomic surveys. Moreover, reducing morbidity rates through improved preventative and curative care is often one principal criterion used to evaluate whether the "basic needs" of a society are being met.

Establishing why the data are collected will influence the amount of detail required in each topic area, the person to be questioned, and the frequency of collection. Kroeger (1983: 473) argues that the greatest value of health interview surveys lies in their ability to test sociomedical hypotheses; to examine people's use of and faith in different kinds of health services; and to explore the survey's potential for making comparisons across cultures, within nations, and even across international borders. Most surveys gather information on self-perceived morbidity and resulting actions in seeking treatment. In addition, the survey often needs health-related information to serve as control variables for nutritional status information. For instance, does a child have a low weight-for-age because she is malnourished or because she fell ill during the preceding week or two?

Most researchers view self-assessment of an individual's health status using the interview approach as being a more cost-effective approach than determining a clinically measured health status (Kroeger 1983). However, social context and emotional factors condition the self- or proxy-reported assessments. In designing the health interview instrument, researchers must use qualitative and quantitative approaches in a complementary fashion if they are to obtain meaningful results.

CONCEPTUAL ISSUES

Reliability of Recall Assessments of Health Status

Researchers have undertaken health interview surveys since the 1920s in industrialized countries and since the 1950s in developing nations (Kroeger 1983: 465). Comprehensive reviews by Ross and Vaughan (1986) and Kroeger (1983) describe numerous shortcomings in surveys' methodological design that will limit their use by planners of health services and other researchers. Kroeger (1983: 470) cites five common failings in health interview surveys:

1. Variations in survey design and methodological quality limit a survey's value and comparability.

2. The survey may fail to understand the local perception of what does or does not constitute disease, the causes of particular maladies, and how those perceptions may change over time. Surveys often neglect culture-specific disease classifications. Most studies use open-ended questions instead of developing a standardized list of "tracer conditions" (i.e., a comprehensive list of symptoms indicative of ill health).

3. Some studies frequently neglect traditional healing systems or self-treatment efforts in relation to their use.

4. Severe response errors occur, especially during the early phases, because of failure to recognize local taboos.

5. Surveys obtain unreliable prevalence estimates because they lack awareness of the limitations inherent in the interview approach.

Above all, it is important to remember that recall assessment of health status is only a proxy for clinically measured health status. A supplementary study conducted during a longitudinal survey of rural Guatemalan children (Martorell et al. 1975) compared 742 mothers' reports of the health status of their under-fives on the day of interview with an independent diagnosis by a physician on the same day. Perceptions differed considerably. For example, only 66 percent of the under-fives whom the doctor classified as having diarrhea were reported by the mothers as having diarrhea, although 99 percent of the children who were considered diarrhea-free by the physician were also considered diarrhea-free by the mothers. The pattern varied with the particular disease. More than 90 percent of the mothers were able to correctly identify respiratory illness in their children, but only 64 percent of the children that the physician considered *not* to be suffering from a respiratory ailment were identified as such by their mothers.

Although such discrepancies may be inevitable, carefully designed health interviews can nonetheless be useful. Household interviews in rural Tanzania (Degremont et al. 1987) yielded similar results to clinical examinations for the two major health problems (fever or malaria, abdominal pain or discomfort) mentioned by both adults and children. Moreover, a parent's perception of severity and cause of child morbidity may be critical in determining the kind and timing of health care sought. Kroeger (1983) and Ross and Vaughan (1986) do not call for abandoning the health interview approach but rather for refining and standardizing methodology so that meaningful results can be obtained.

Bias Introduced by Memory Recall

Much of the discussion regarding health interview methodology has centered around the respondent's ability to recall the duration of symptoms and the use of health care systems. Ideally, researchers like daily records of information, but this usually is infeasible. Daily visits by enumerators are costly and fatiguing for respondents. Less-frequent visits lead to the omission of important data. In the past, researchers often used reporting periods of as long as 12 months, but we now generally accept that we cannot obtain reliable data over such a long interval (Kroeger 1983: 466).

When designing the instrument, researchers must consider two possible biases that are introduced by relying on memory recall: (1) bias caused by under-reporting, and (2) bias caused by over-reporting. In their assessment of twice-monthly, symptom-oriented, retrospective interviews of mothers in four rural Guatemalan villages, Martorell et al. (1976) noted three "properties" for mothers who under-reported their child's illnesses:

1. Under-reporting increases as the time lapse increases between occurrence and interview.
2. The less serious an event, the more prone it is to under-reporting.
3. Under-reporting is more likely to occur for acute symptoms or events of shorter duration than for longer-lasting or chronic events.

Thus, under-reporting is directly related to the mean duration of a particular symptom. In certain instances, the short duration of an event may result in a person's failure to recall it, even when the illness was severe. This bias is particularly important for researchers interested in monitoring major illnesses affecting young children. Relatively more serious symptoms, such as fever, vomiting, diarrhea, and bloody stools, were frequently the symptoms of shortest duration and consequently the most under-reported during a study in Guatemala. The less-serious symptoms, which persisted, such as coughs, colds, and skin problems, were the least under-reported (Martorell et al. 1976: 133).

A child morbidity study in Zaire (Tsui et al. 1988) examined a more elusive cause of under-reporting. Perplexed by results indicating that children of uneducated mothers had a lower risk of morbidity, the researchers reanalyzed the sample, stratifying by level of maternal education. They concluded that maternal education mediates the reporting of diarrheal episodes, one of the major foci of their study. Hence, the apparent reduced rates of morbidity among the poorer, uneducated mothers were attributed to under-reporting rather than a true difference in morbidity. The authors hypothesized that more formal education for women leads to improved health knowledge, thereby enhancing the mother's ability to recognize and accurately report illnesses.

Problems of over-reporting may also occur. In a comparative study of four different methods for determining child health status in Tanzania, Degremont et al. (1987) remarked that respondents in the health interviews gave higher ranking to health problems not yet solved by health care facilities. They felt that additional biases were introduced when they used interviewers who also worked as health care staff. Cumulative experience points toward the superiority of using lay people as opposed to health personnel in conducting health interview surveys, particularly if information is desired on the use of more "traditional" health services (Kroeger 1983, and Ross and Vaughan 1986).

In longitudinal studies, researchers must consider the tendency for respondents' perceptions of illness to alter over time. Because of concurrent health interventions in the Tanzanian case, awareness of the symptoms of diseases such as schistosomiasis improved; consequently, their symptoms were reported more often.

METHODOLOGY AND ORGANIZATION

Choice of Interview Techniques

Researchers commonly use two approaches in conducting health interview surveys: (1) the *open-ended* approach asks the respondent to report if any illness has occurred during the recall period, and to specify what his or her symptoms were; and (2) the *tracer condition* approach uses a symptom checklist (e.g., "Have you ever had fever during the last two weeks? Have you ever had diarrhea?"). Kroeger (1983) advocated the tracer condition approach as the best way to overcome under-reporting, of because a "standardized" interview approach does not rely on the respondent's ability to describe his or her symptoms. Ross and Vaughan (1986: 85) point out that use of a symptom check list can lead to relative over-reporting of minor episodes involving the listed conditions, whereas any symptoms omitted from the list tend to be under-reported. There is widespread agreement that if the tracer condition approach is adopted, the contents of the list must be based on extensive qualitative research into local perceptions of disease and disease patterns. The tracer list must be pilot tested for problems such as over-reporting symptoms because respondents tend to want to "satisfy" the interviewer. Moreover, if lists are used, the order of items on the list must be varied among subgroups of respondents to avoid biases in response because of a symptom's position on the list (Ross and Vaughan 1986: 93).

In his research on illness, work, and social relations in Peru, Leatherman (1987: 86) combined the two approaches:

> The perceived morbidity questionnaire began by asking if the individual was suffering from any identifiable illness. It then proceeded through different body parts and systems, including: head and sensory organs; chest, lungs, and heart of the cardio-pulmonary system; stomach and gastro-intestinal system; uro-genital system; and back, joints and extremities of the skeletal-muscular system. The procedure was to ask for descriptions of any general problems and supplement these "open-ended" questions with "yes-no" questions on specific "tracer" conditions. The use of close-ended "tracer"

> conditions along with open-ended description often improves the accuracy of response, and was designed in part to control for individual boredom which might have resulted in artificially consistent positive or negative responses. Descriptions reported in open-ended questions were allowed to supersede a yes-no response if the two were in direct contradiction.

Leatherman found that this approach provided him with accurate data relevant for a non-Western population, because respondents described conditions in their own words. Given that the consequences of morbidity were the major focus of his dissertation, he felt this level of accuracy was necessary. He noted, however, that the complexity of procedures decreased the "standardization" of the instrument. Implementation of such an approach requires highly trained interviewers.

Leatherman also tried to assess the severity of illness by creating a weighted "work disruption" variable. First, the interviewer asked each adult if she or he had been unable to carry out normal activities because of an illness or related problem during the previous two weeks. Each day of disruption was classified in one of three categories: (1) severe (rest in bed), (2) moderate (perform only nonstrenuous sedentary activities), and (3) negligible (continue to work). One day of bed rest equaled one day lost, whereas one day of nonstrenuous activities was treated as a half-day lost (Leatherman 1987: 88).

Integrating Cultural Considerations

We cannot overemphasize the importance of taking the time to do adequate qualitative research before launching the interview survey. At a minimum, researchers need to establish:

1. Culturally specific dimensions of disease;
   - How does one know when a child is healthy or is ill?
   - How does one keep a child from falling ill?
   - What are considered to be the causes of the most common diseases?
2. Description of the symptoms of each disease in the local language and its perceived seriousness;
3. Knowledge of the seasonal patterns of each disease;
4. Treatment for each disease and by whom it is usually done; and
5. Assessment of alternative sources of care;
   - How willing are respondents to discuss these alternative sources?
   - Are there illegal activities (e.g., abortion in most African countries) that have medical implications? How are these types of activities referred to within the community?

Holding group discussions or interviews with so-called "key informants" often provides answers that correspond to given social rules. Enumerators should always attempt to interview more than one key informant and to probe for their own opinions in addition to what is the culturally acceptable norm. Moreover, enumerators should attempt to interview small groups of women in private if that is permissible in the given cultural context. Hiring interviewers from the same ethnic and social groups as the respondents can aid in avoiding many errors, particularly if the interviewers are encouraged to participate in instrument design.

Common diseases may be under-reported, which must be considered when designing questionnaires. In Malawi, for example, mothers considered diarrhea to be normal in young children (i.e., part of the child's normal health status). Moreover, colds were so common in the upland areas that they were rarely considered an illness. To overcome this problem, interviewers were asked to supplement the original open-ended questionnaire with probes for specific diseases, including diarrhea, fever, cough, and runny nose.

Some diseases are easily identified while others are not. Measles has a distinct set of symptoms widely recognized by the community. Other diseases, such as malaria, are difficult to distinguish from other maladies involving high fever. In Malawi, malaria was hyperendemic in the area; consequently, when respondents suffering from fever went to a clinic, they were treated for malaria without any laboratory confirmation of the disease's presence.

In Malawi, the perceived cause of disease often determines the kind of treatment initially sought. If the disease is attributed to bewitchment or adulterous behavior, then local medicine from a *sing'anga* (traditional healer) is felt to be most appropriate. Other illnesses are treated at the clinic. When clinic treatment fails to produce a response, then villagers turn to local medicine. Given that more than one health care provider is often consulted when an event persisted, the survey provides space to record two sources of treatment.

The exploratory assessment is necessary but not sufficient. Interviewers should be encouraged to record any unusual events. Certain practices may come to light as respondents feel more comfortable with the interview process itself. For instance, several months into the Southern Malawi study, interviewers discovered that certain respondents received injections from people who came to their homes. These *amajekison* (literally "injectors") were not government health workers, and this activity was illegal. However, once the interview team was aware of the *amajekison*, team members began to probe for this type of treatment in other households and found that, indeed, injectors were consulted for illnesses in one-third of the cases where treatment was sought.

Leatherman (1987) used two other anthropological techniques to familiarize himself with health patterns and perceptions. He collected health histories in an attempt to evaluate the impact of serious bouts of illness on household members throughout their life cycle. In addition, he asked the female head of each household to rank the health status of the family relative to others within the same community. Such qualitative information may help place subsequent quantitative results in proper perspective.

"Perceived" and "Disabling" Morbidity

Researchers collect these two distinct categories of morbidity information at the individual level. Typically, perceived morbidity is investigated by recording for each bout of illness: symptoms, duration, treatment, expense, results, and, less frequently, who decided on treatment. Since younger children (particularly those in the first three years of life) are very susceptible to infections (Martorell and Habicht 1986), data collection on perceived morbidity is frequently restricted to the under-fives age group. If the research focus is on disabling morbidity, interviewers often collect information on the number of days adult members of the household were unable to perform their normal tasks. This definition of morbidity has more methodological difficulties than does the symptomatological approach. An individual's perception of the seriousness of his or her illness, coupled with society's behavioral expectations, often influence an ill person's response to questions regarding reduction of normal working hours or intensity.

The Northern Malawi study showed a specific interest in describing the seasonal patterns of morbidity in both under-fives and adults. In addition, the impact of disabling morbidity on labor productivity of household members, particularly women, was of interest. For this reason, interviewers collected data on perceived and disabling morbidity data for all household members. Appendix E contains a copy of the form used for data collection of this module, including instructions and codes. The form provides space to record the three most debilitating symptoms that each individual suffered during the month-long recall period and the duration of each symptom in days. From there, the enumerator probed to find out whether all the symptoms were concurrent or not. In separate columns, the enumerator noted the total number of days ill, the number of days the ill person ceased eating because of illness, and the number of days an adult was unable to engage in normal work activities. If the ill child or adult was cared for by another person, the interviewer recorded the identification number of the principal care giver and the number of workdays the care giver lost while looking after the ill person. Appendix F provides another example of a morbidity questionnaire.

Studies commonly calculate two types of morbidity rates: incidence rates and point prevalence rates (Ross and Vaughan 1986).[14] To report the incidence

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[14] Epidemiologists are careful to distinguish between rates of incidence and rates of prevalence. Incidence rates assess "the probability that healthy people will develop a disease during a specified period of time" (Mausner and Kramer 1985: 44). Hence,

(continued...)

rate of morbidity over the recall period in cross-sectional surveys, interviewers must record the illness episodes that began before the recall period and must analyze those episodes separately from the ones that began during the recall period. If the point prevalence is desired, enumerators must note information on the symptoms or disabilities incurred on the day of or the day before the interview (Ross and Vaughan 1986: 78). Because of under-reporting, prevalence estimates based on longer recall periods will substantially underestimate the prevalence of common childhood ailments (Kroeger 1983: 466).

Frequency of Data Collection

Given the inaccuracies introduced through under-reporting, Kroeger (1983: 477) concludes that questions on perceived morbidity with a recall period of more than two weeks will provide "uncontrollable" results. Ross and Vaughan (1986: 84) point to accumulated evidence that suggests a two- to four-week recall period is a reasonable compromise between having a period long enough to include an acceptable number of illness episodes and a period short enough to minimize recall error. They note that for cross-sectional studies, the major disadvantage of using a recall period shorter than 12 months is that results cannot be used to project annual rates of morbidity because the incidence of many illnesses varies by season (Ross and Vaughan 1986: 85). Researchers must clearly state whether or not they include illnesses that started before the recall period. If prior illnesses are excluded, they should consider collecting point prevalence of *all* morbidity on the day of interview to capture chronic illnesses (Ross and Vaughan 1986: 93).

Again, the ultimate choice of recall period depends on the purpose of the survey. When morbidity surveys are undertaken as components of larger socioeconomic studies, two- to four-week recall periods will suffice. However, as pointed out in work done on diarrhea recall surveys by Alam et al. (1989) in rural Bangladesh, even one-week recall periods are subject to reporting error. Their results show that weekly diarrhea recall surveys underestimated severe

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[14] (...continued)

$$\text{Incidence rate} = \frac{\text{Number of new cases of a disease over a period of time}}{\text{Population at risk}}$$

On the other hand, a prevalence rate calculates the number of people in the total population who *already have* the disease at a given time. Thus,

$$\text{Prevalence rate} = \frac{\text{Number of existing cases of a disease at a point in time}}{\text{Total population}}$$

Point prevalence depends on the number of people who were previously ill and the duration of their illness. If the incidence and duration of a particular disease is stable over time, then

$$\text{Prevalence} = \text{Incidence} \times \text{Duration}$$ (see Mausner and Kramer 1985: 44).

diarrhea cases by 20-22 percent and less severe by 42-44 percent. Moreover, the respondents reported an average of 34 percent fewer diarrhea episodes when the recall period was longer than 48 hours in any week. This implies that when researchers consider accurate figures concerning diarrhea morbidity to be crucial to the planning process, twice-weekly visits are necessary to ensure accuracy. Because such frequent visits are infeasible in many studies, researchers should try to quantify any reporting errors in surveys with longer recall periods. Quantification of reporting errors permits the derivation of a correction factor if a goal is to have the most accurate assessment of diarrhea morbidity (Alam et al. 1989: 699).

Whatever the final recall period selected, Ross and Vaughan (1986: 84) propose that researchers estimate the degree of recall error simply by dividing the total recall period into equal sections, and by inquiring separately about events occurring in each section. This approach, however, increases the length of the interview so enumerators may want to use it only with a subsample or to use it periodically in the case of longitudinal studies.

Proxy Versus Self-Reported Assessments

Ideally, morbidity data should be self-reported, not proxy reported. In the case of young children, researchers usually choose the principal care giver (most often the mother, grandmother, or aunt) as the respondent. If using proxy respondents in the case of adults, researchers can analyze the results from proxy interviews separately from self-reported interviews and test for differences (Ross and Vaughan 1986: 92).

Use of Health Services

The ultimate purpose dictates the extent of data collection regarding use of health services. If the aim is to provide information for health planners and policymakers, researchers often obtain detailed information on the reasons for choosing a particular source of care, degree of satisfaction with care, and respondent's attitudes toward different health care providers. Scrimshaw and Hurtado (1987) provide data collection guides about both primary health care providers and users of health care services. Most socioeconomic studies, however, include only limited protocols on health service use. In the Northern Malawi study, researchers collected data on the source of treatment, the kind of treatment received for the particular bout of illness, and the total cost of any treatment sought as part of the morbidity module (see Appendix E).

Importance of Community-Level Indicators

Ross and Vaughan (1986: 92) point out that many health interview surveys fail to control for possible mitigating factors such as socioeconomic status or distance to the nearest health facility. Many control variables discussed in the anthropometric section are also relevant to an analysis of morbidity data.

Clearly, it is desirable to collect community-level data on the distance, type, and cost of transportation to health resources. Other information concerning the congestion of health facilities, the availability and cost of medicines, and the presence and competence of health personnel may help to explain why respondents make certain choices in health care.

Strauss (1990) advocates using community-level information, including the availability and cost of health facilities, water, and sanitation, as explanatory variabilities when modeling nutrition outcomes. This approach, he argues, is preferable to using individual morbidity indicators, such as diarrhea or fever, as explanatory variables. His argument is based on evidence that suggests a two-way relationship between illness and growth: ill children are less likely to grow well but, on the other hand, a child who is not growing well is more likely to fall ill. In studies where there is a considerable variation in the types of facilities available at the community-level, researchers whose principal goal is to model nutrition outcomes (weight-for-height, height-for-age) may want to consider concentrating their resources on collecting accurate community-level data and may forgo extensive individual-level morbidity data. Those planning to incorporate individual-level morbidity data into their analyses should consult Behrman and Deolalikar (1988), Strauss (1990), Briscoe et al. (1989), and the Cebu Study Team (1991) for a discussion of how to deal with the problem of endogeneity (i.e., when health and behavioral variables are determined simultaneously).

4. DIETARY INTAKE AT THE INDIVIDUAL LEVEL

The choice of method for determining the mean level and distribution of food intake by the household depends on the purpose of the study and the resources available to the researcher. The most cost-effective way to characterize the average intake of a large group is the single, 24-hour recall, which is randomly distributed across days of the week and seasons.

The best method will differ if the distribution of food resources among individual household members or the absolute magnitude of average food intake by certain individuals is assessed. Before choosing a method, the researcher must be aware of the accuracy and suitability of each approach for the target group(s) under consideration. First and foremost, researchers must decide whether estimating the typical or average pattern of intake among groups is sufficient to meet the study's objectives or whether it is necessary to incur the additional cost of accurately estimating the habitual nutrient intakes of individuals.

CONCEPTUAL ISSUES

The Accuracy of Different Dietary Intake Methodologies

Westerners tend to believe that the use of scales or other scientifically "objective" instruments will yield results that are superior to approaches that rely on memory recall or estimations. This tendency is particularly true regarding the collection of food intake data at the individual level, where improving the precision of measurement is of greater concern than at the household level. The weighed record is often considered the most accurate method of dietary assessment because the quantity of food consumed is actually weighed and recorded. In many instances, trials conducted to determine the validity of 24-hour recall, diet history, or semiquantitative food frequency questionnaires will use the weighed intake values as the "gold standard" against which to compare the recall methodologies. For example, Ferguson et al. (1989) compared dietary data collected by 24-hour recall with the weighed record of food intake for the same day for 29 rural Malawian children.

In field research situations, the assumption that the weighed record is the most accurate method of dietary assessment may not be valid because of biases introduced by the technique itself. Weighing either the prepared food and/or the raw ingredients inevitably disrupts normal preparation and eating of meals. In African settings, researchers may ask individuals who normally eat out of a common pot with other household members to eat separately. The portions they serve themselves may be substantially different from those normally taken, particularly if the participant is unsure of what use will be made of the results. For instance, the individual may take less than the usual portion if she thinks low intake may be linked with qualifying for assistance; conversely the portion may be larger than usual if the individual thinks it will please the researcher. Moreover, there is a danger that between-meal snacks and other food consumed away from home may be under-reported, unless the researcher follows individuals throughout the entire period. Because of the time demands involved in weighing the food, the participant may decide to prepare less food than usual to speed up the data collection process. Finally, even if the items in question are accurately weighed and recorded, subsequent errors that are introduced in converting ingredients into nutrients may be so large that little, if any, improvement in accuracy is gained over recall methods.

Thus, the aura of achieving greater precision can be negated by distortions from normal behavior. Some studies discard the initial visits as unrepresentative; the researchers feel that once participants are accustomed to having their food weighed, they are more likely to engage in typical eating patterns. In the future, researchers expect to make greater use of the doubly labeled water technique to assess the validity of weighed intake records. The doubly labeled water technique permits the estimation of energy expenditure levels that can be compared to energy intake levels.[15] For instance, Bingham et al. (1988) reported preliminary results from a maternal dietary supplementation program in The Gambia, indicating that energy intake as determined by the observed weighed intake method was lower than energy expenditure measured using the doubly labeled water technique. Unless significant weight loss occurred in these subjects, the results show that the weighed record method underestimates overall consumption. However, the doubly labeled water technique is also subject to measurement error and is expensive to administer. Clearly, researchers need further refinement of validation procedures so they can properly evaluate dietary intake methodology.

The Perception of What Constitutes Food

Western cultures developed methodologies for assessing dietary intake. Questions designed to elicit recall information are often conceived in a language that is not the maternal tongue of the respondents. Even if such questions are subsequently translated, the translation is often done with insufficient regard to intercultural differences in the meanings of words. Evidence from Malawi shows that particular attention should be paid to how a society conceptualizes

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[15] The biology underlying the doubly labeled water method is that the oxygen (O) atoms in body water are isotopically equilibrated with O atoms in expired carbon monoxide (CO). Therefore, if a researcher administers a dose of water labeled with ^2H (deuterium) and ^{18}O, the labeled deuterium is expelled from the body as water, while the labeled O is eliminated as water and carbon dioxide (CO_2). Since the difference between the two elimination rates is proportional to CO_2 production, the researcher has a measure of energy expenditure (Schoeller and van Santen 1982). Refer to Schofield et al. (1990) for other methods for calculating human energy requirements.

what constitutes "eating." In most maize-staple households, families felt they had not eaten unless a meal included the staple food nsima (a stiff maize porridge). Thus, the answer to questions such as "When did you last eat?" or "Have you eaten today?" could lead to under-reporting of total consumption because meals consisting of fruits, vegetables, and other "snack" foods may not be considered relevant by the respondent. Likewise, individuals in Indonesia reported that they had not eaten anything if they had not had a meal with rice. So, even if they had coffee and sweet potatoes for breakfast, they would respond that they had not eaten in the morning.

Jarosz (1990) documented how the use of culturally appropriate terminology can substantially alter results. When trying to assess the mean age for introducing nonbreast milk foods to Liberian infants, Jarosz avoided the terms "food" and "to eat" literally translated from the English language. By using words with more general meaning (i.e., "thing" for food and "had" for eat), she obtained mean ages of nonbreast milk food introduction that are 2 to 4 months earlier than those determined in previous studies conducted in Liberia. Her results were consistent with observed infant feeding practices.

Therefore, researchers opting for recall methodologies to assess dietary patterns or intake will need to establish the culturally specific dimensions of what constitutes food. Questions should be pretested in the vernacular, with explicit attention paid to choice of wording.

METHODOLOGY AND ORGANIZATION

Both Gibson (1990: Chapter 3) and Cameron and Van Staveren (1988: Chapter 6) reviewed the appropriateness of available methods for measuring individual food intake. Gibson's recommendation on choice of methodology depended on the study's objective. Three major objectives are encountered in dietary surveys, each having a distinct methodology most suited to the particular goal:

1. Individual pattern of food use for which the food frequency questionnaire would permit ranking of individuals according to high, low, or medium use of a particular food item;

2. Typical individual food intake for which multiple replications of 24-hour recall or estimated records on each individual generate sufficient precision for most regression analyses; and

3. Actual nutrient intake over a finite time period, which requires the calculation of nutrient intake from weighed records.

We listed the three methods in order of increasing complexity, cost, and information provided. While it may take more time to develop and pretest the food frequency questionnaire, it is the simplest and quickest to administer. Frequency questionnaires should include those foods that can be used to differentiate groups on the basis of consumption patterns, that is, those that contribute to the variance of the diet (Cameron and Van Staveren 1983: 93). For example, in Northern Malawi, the ability of households to buy cooking oil varied considerably. Since that oil was a major source of fat in the diet, it was included in the food frequency questionnaire.

Researchers can use information from food frequency questionnaires to derive dietary diversity scores. The rationale behind these scores is that greater dietary diversity is associated with a wider range of ingested nutrients, which enhances the likelihood that the body's nutritional needs will be met. Positive relationships are found between dietary diversity and overall nutrient intake, as well as certain anthropometric indices of nutritional status (Sanjur 1982). Nzungize (1989) designed a food frequency questionnaire to record how often some commonly used foods were given to children included in her study in Southern Malawi (see Appendix G). She assigned weights according to frequency of consumption, with those consumed every day being given a higher weight than those consumed occasionally. She then derived the diversity score by adding all the weighted values together. Sanjur (1982: 217-224) described other food scores, nutrient scores, and food quality indices that were currently in use. See Gibson (1990) for other examples of food frequency questionnaires.

Food frequency questionnaires are *not* appropriate, however, for estimating levels of energy intake. The most commonly used approaches in field studies for estimating usual individual intake are to rely on multiple 24-hour recall or estimated record data. The number of observations required is much greater for individual-level assessments than for group-level assessments because of the normal day-to-day variation in nutrient intake.

According to Bingham et al. (1988: 62) whereas one to four days of observations may be sufficient for determining group averages (depending on your sample size), seven days would be required to attain a precision of plus or minus 10 percent standard error of the mean at the individual level for protein, energy, and carbohydrates. Moreover, for more variable nutrients (such as iron and calcium), a minimum of 14 days would be necessary to attain the same level of precision. The more daily variation the diet has for the specific population group under study, the greater the number of recalls that must be conducted. Researchers should randomly schedule observations over seasons and days of the week.

Weighed records were collected at the individual level in only one of the six case studies: the Southern Malawi study. This study placed particular emphasis on measuring differences in nutritional status among groups of selected target children and their mothers, with one child taken from each household. An enumerator spent an entire day during the "hunger" season and another full day during the postharvest season at each study household. The study was hypothesized that seasonal variation in diet would be greater than daily variation in food components. Thus, individual-level data were collected with enough precision to determine group means for the mothers and target children, but not to distinguish among individuals.

Appendix H shows the forms used to record the dietary data. Separate forms recorded mother and target child intakes. The remaining household members' communal intake was also weighed and recorded, and the age and sex of each member of an eating group was noted. The form provided space to record if either the mother or child was ill during the weighing day. The enumerator was also asked to assess whether she believed that the types and amounts of foods eaten that particular day were "usual" for that household. The inclusion of such information aids when cleaning the data to determine whether a particularly high or low value is legitimate.

The approximate 550 days of enumerator time and supervisory management required to conduct this component of the study demanded one-quarter of the research budget. Thus, researchers should seriously consider whether such an investment in collecting food intake data at the individual level is indeed necessary to test their research hypotheses.

PROBLEMS ENCOUNTERED

Collecting Information on Children

The purpose of the research will determine which household members to include in individual-level data collection. If distribution of food among all household members is an issue, researchers should collect dietary information for each individual member; however, the cost and administrative burden of such an approach may be excessive. Researchers often confine surveys to more vulnerable members of the household, particularly under-five children and pregnant or lactating women. In determining nutritional status, researchers need dietary information on the same individuals from whom they obtained anthropometric measurements.

Two special problems arise when researchers want information on young children. First, children who are less than nine years old are not capable of providing accurate information about their diet. If food intake cannot be precisely weighed for these children, relying on the child's principal care giver to recall intake will result in figures that typically produce underestimates. Second, infants and toddlers who are not yet weaned receive a significant proportion of their calories from breast milk. It is time-consuming and very problematical to quantify the amount of calories derived from breast milk, although some researchers attempt estimates by recording time spent actively breast-feeding and multiplying this figure by average rates of milk production reported from other surveys.

The Southern Malawi study attempts to overcome these problems by selecting a "target" child for whom all intake was weighed separately from other children. If more than one under-five was present in the household, researchers selected the under-five closest to three years of age. Choosing children of this age avoids the problem of trying to quantify breast milk calories. Moreover, weaned children are often at greater risk of illness than those who are still breast-feeding. Therefore, if the focus of the research is on the most vulnerable members of the household, this is a sensible selection criterion for choosing the "target" child.

Communal Eating Units

Earlier we discussed the distortion introduced by separating individuals from their normal communal eating group to obtain individual-level data. Another major problem involved in dealing with large communal eating units is that several cooks may be involved in food preparation. Moreover, those responsible for preparing the noontime meal may differ from those responsible for the evening meal. In such cases, preliminary investigations indicate that it is necessary to use two sets of weighing equipment (if the weighing record approach is used) or a team of enumerators (if the recall method is employed) so that data collection can be completed accurately and in a timely fashion. In certain societies where an evening meal is cooked and the leftovers kept for consumption the next day, the most appropriate 24-hour recall period to choose may be the one beginning at an evening meal and continuing to the next evening meal, rather than the more commonly designated period of consumption during a given calendar day.

Bingham et al. (1988: 67) suggest that one approach to recording individual intake when foods are eaten from one or more communal pots is to count the number of times the individual takes a certain type of food from the pot and multiply this by the average weight of a typical serving. If the food in the pot is homogeneous, enumerators can establish an average serving weight by asking an individual to remove 10 typical servings and then use the mean value of those servings in the final calculation. However, estimating portion weights will introduce considerable inaccuracy. Moreover, survey personnel must watch the individual closely during the entire meal, which would likely disrupt the individual's normal eating pattern. Most researchers prefer to accept the distortions introduced by asking the subject to eat from a separate plate.

A possible alternative that might enable a researcher to deal with distributional issues in food consumption but to avoid the biases introduced by separating individuals from their eating groups is to focus on the eating group itself. For example, if in a large communal household the men eat together, the adult women and older girls eat together, the boys eat together, and the younger children eat together, then enumerators can collect dietary information on all or a selected subset of these eating groups. The mean per capita intake for each group can then be determined and compared.

5. CONCLUSION

Throughout this working paper series, our recurrent message has been that the principal objectives of the survey will drive the selection of variables to consider and the degree of detail needed in health and nutrition modules. To obtain meaningful results, researchers must give considerable thought to sample size and to quality control during training periods and while collecting data.

If the researcher is interested only in having an additional indicator of household well-being as one part of a larger study, then it is better to collect a wide range of information on a subsample of household members than, for instance, to measure weight and height for all household members. One realistic approach is to collect only individual-level data on under-fives and community-level data on the non-nutritional influences on health, such as distance to clinics and sources of drinking water. To minimize cost, the researcher need collect only the following information on under-fives: (1) weight and stature; (2) two- to four-week recall on common illnesses (diarrhea, respiratory, fever) and loss of appetite; (3) an individual-level, food-frequency questionnaire from which a diversity or other food score can be derived; and (4) the relevant control variables. In many cases, the additional burden incurred in measuring arm circumference is not very demanding and permits some confirmation of the severity of PEM.

Any time anthropometric measurements are taken, researchers should carefully consider how reliability assessments will be integrated into the training and data collection process, both in cost and time. Similarly, they should consider the cost of calibrating and maintaining equipment when budgeting field surveys.

For studies in which labor productivity, nutritional outcomes, or intrahousehold food distribution are the major foci, a diversity of approaches may be appropriate. Although this working paper presented these methods separately, researchers are encouraged to combine qualitative and quantitative approaches as a way of achieving a deeper understanding of the underlying behavior that drives decisions regarding health care or nutrient intake. It is best for researchers to avoid blind adherence to quantitative methodologies that distort normal patterns of behavior.

APPENDIX A

NUTRITIONAL STATUS SUMMARY PROCEDURES

Nutritional Status Measurement
Summary Procedures

A. Child Height Summary Procedure (Illustration 1)*

1. **Measurer or Assistant:** Place the measuring board on a hard flat surface against a wall, table, tree, staircase, etc. Make sure the board is stable.

2. **Measurer or Assistant:** Ask the mother to remove the child's shoes and unbraid any hair that would interfere with the height measurement. Ask her to walk the child to the board and to kneel in front of the child (if she is not the assistant).

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

4. **Measurer:** Kneel on your right knee only, for maximum mobility, on the child's left side (Arrow 3).

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

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

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

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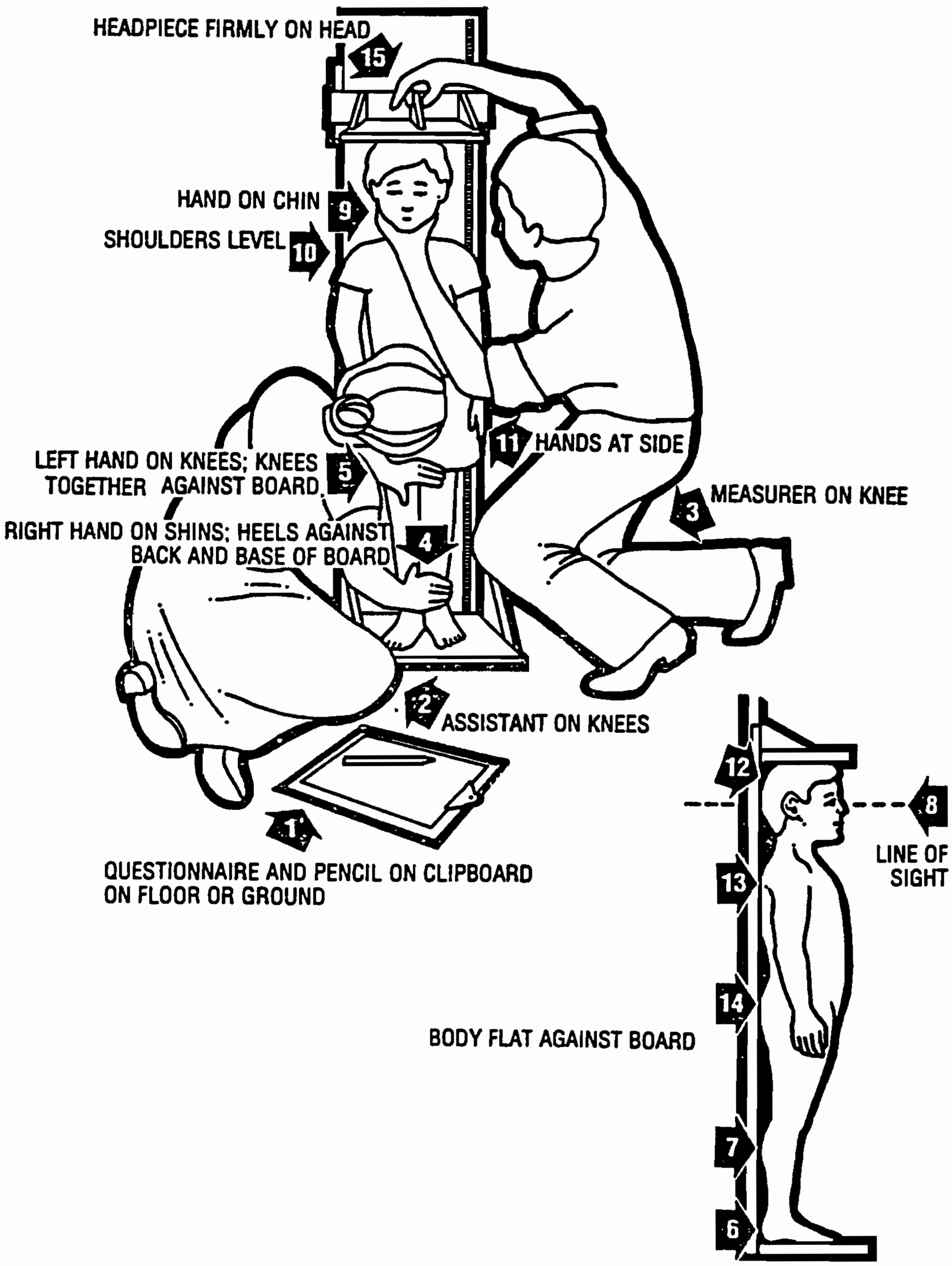
* If the assistant is untrained, e.g., the mother, then the measurer should help the assistant with the height procedure.

Appendix A (continued)

Illustration 1

Child Height Measurement



Appendix A (continued)

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

9. **Assistant:** Immediately record the measurement and show it to the measurer. **NOTE:** If the assistant is untrained, the measurer records the height.

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

B. Child Length Summary Procedure (Illustration 2)*

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

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

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

4. **Measurer and Assistant:** With the mother's help, lay the child on the board by doing the following:

   Assistant: Support the back of the child's head with your hands and gradually lower the child onto the board.

   Measurer: Support the child at the trunk of the body.

5. **Measurer or Assistant:** If she is not the assistant, ask the mother to kneel on the opposite side of the board facing the measurer to help keep the child calm.

6. **Assistant:** Cup your hands over the child's ears (Arrow 4). With your arms comfortably straight (Arrow 5), place the child's head against the base of the board so that the child is looking straight up. The child's line of sight should be perpendicular t the ground (Arrow 6). Your head should be straight over the child's head. Look directly into the child's eyes.

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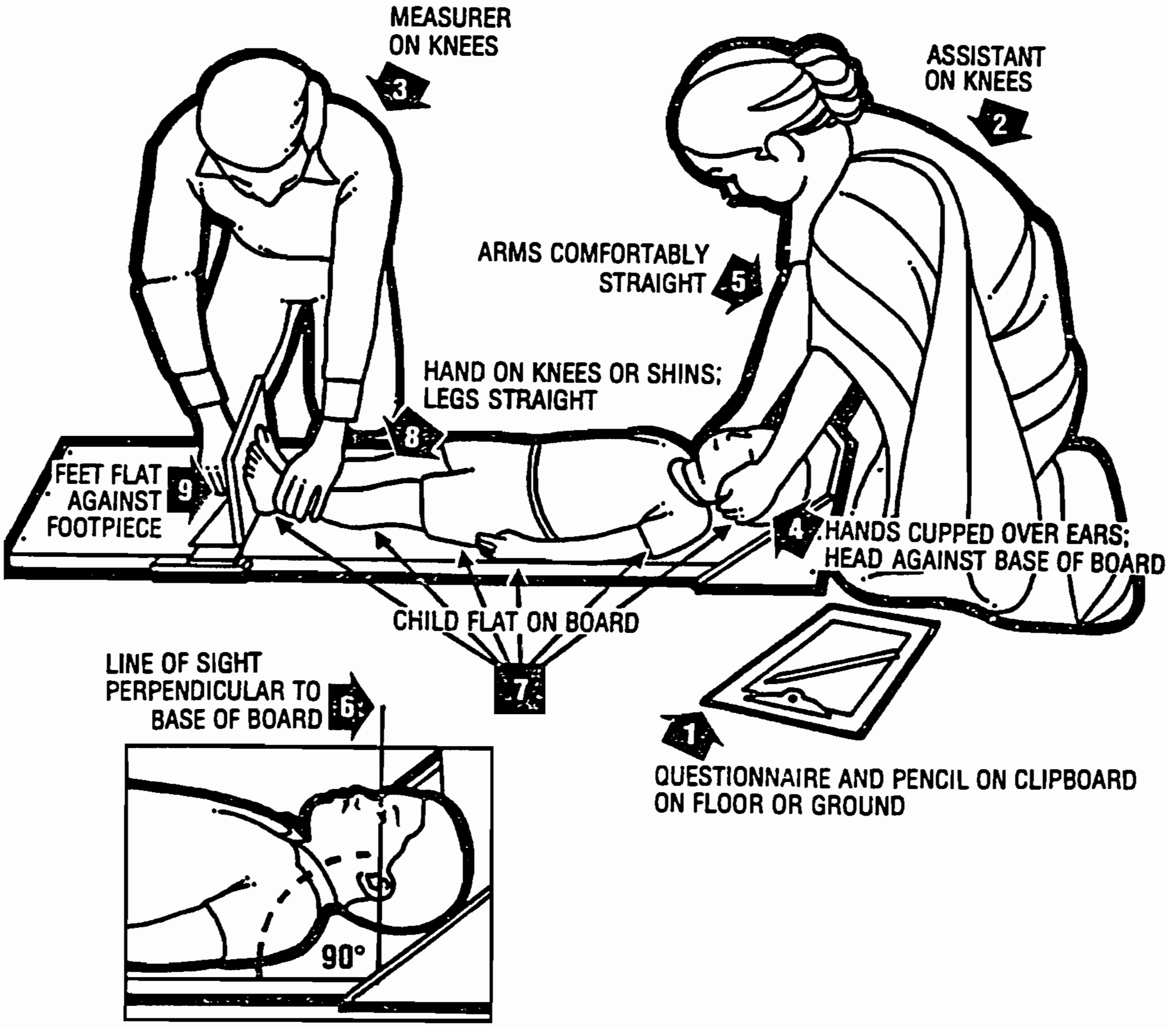
* If the assistant is untrained, e.g., the mother, then the measurer should help the assistant with the length procedure.

Appendix A (continued)

Illustration 2
Child Length Measurement



Appendix A (continued)

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

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

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

10. **Assistant:** Immediately release the child's head, record the measurement, and show it to the measurer.
NOTE: If the assistant is untrained, the measurer records the length on the questionnaire.

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

C. Child Weight Summary Procedure (Illustration 3)*

1. **Measurer or Assistant:** Hand the scale from a tree branch, ceiling beam, tripod, or pole held by two people. You may need a piece of rope to hang the scale at eye level. Ask the mother to undress the child.

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

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

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

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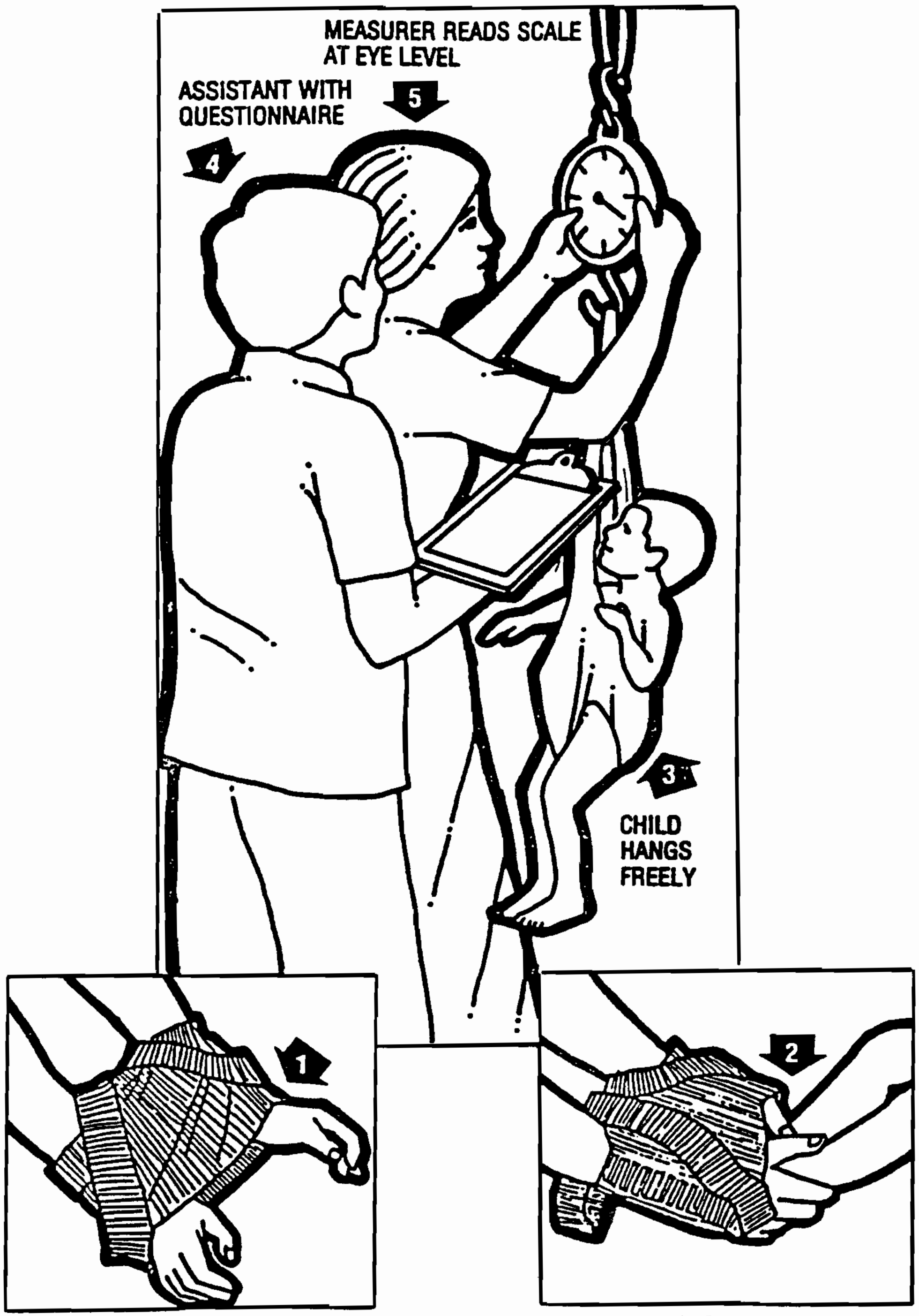
* If the assistant is untrained, e.g. the mother, then the weight should be taken by one person only, the trained measurer, who should also record the measurement on the questionnaire.

Appendix A (continued)

Illustration 3
Child Weight



PUT HANDS THROUGH LEG HOLES

GRASP FEET

Appendix A (continued)

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

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

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

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

9. **Measurer:** As the assistant records the measurement, hold the child in one arm, and gently lift the child by the body. DO NOT LIFT THE CHILD BY THE STRAP OF THE WEIGHING PANTS. Release the strap from the hook of the scale with your free hand.

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

D. Child Mid-Upper Arm Circumference Summary Procedure (MUAC) (Illustration 4)*

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

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

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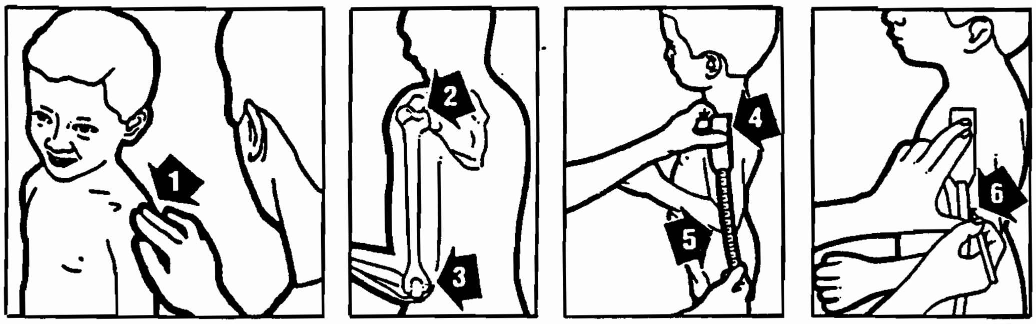
* If the assistant is untrained, e.g. the mother, then arm circumference should be measured by one person only, the trained measurer, who should also record the measurement on the questionnaire.

Appendix A (continued)

Illustration 4

Child Mid-Upper Arm Circumference Measurement

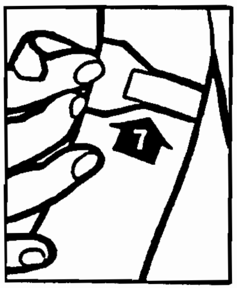


1 LOCATE TIP OF SHOULDER

2 TIP OF SHOULDER
3 TIP OF ELBOW

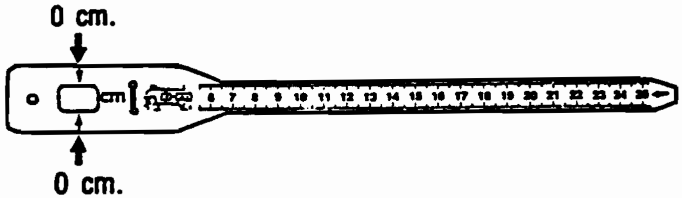
4 PLACE TAPE AT TIP OF SHOULDER
5 PULL TAPE PAST TIP OF BENT ELBOW

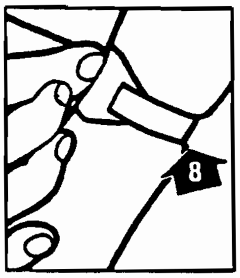
6 MARK MIDPOINT



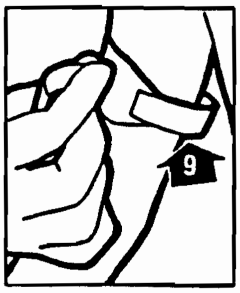
7 CORRECT TAPE TENSION

ARM CIRCUMFERENCE "INSERTION" TAPE

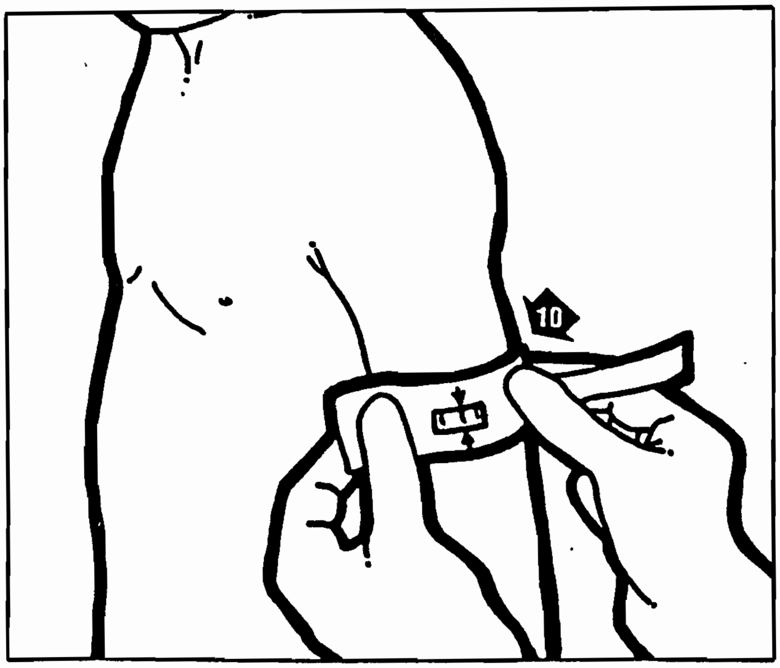




8 TAPE TOO TIGHT



9 TAPE TOO LOOSE



10 CORRECT TAPE POSITION FOR ARM CIRCUMFERENCE

Appendix A (continued)

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

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

5. **Assistant:** Have the questionnaire ready.

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

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

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

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

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

Source: United Nations. 1986. *How to Weigh and Measure Children*, Annex 1, Summary Procedures. New York: United Nations.

APPENDIX B

EXAMPLE OF FORM FOR RECORDING ANTHROPOMETRY

ANTHROPOMETRY

Dist ___ Cluster ___ Vlg ___ Compound ___ Household ___ Study ___

Enumerator ____________

Cluster ____________

Name of eldest ________

Round No. |__|__|

Village ________

IDNO |__|__|__|__|

Date: |_|_|/|_|_|/|_|_|

Super: __ __/__/

Office: __ __/__/

Input: __ __/__/

COMPLETE MEASUREMENTS FOR:

*WOMEN 14-49 years of age: also any elder women with U/5. Note in last column below if woman is pregnant, breastfeeding, both or neither. 1=PREGNANT 2=BREASTFEEDING 3=BOTH 4=NEITHER 9=MISSING OR NA

*FATHERS of U/5's and also father of child of pregnant woman.
HEIGHT DOES NOT NEED TO BE TAKEN ON ADULTS EXCEPT FOR NEW HOUSEHOLD MEMBERS

*ALL CHILDREN U/5
Please remember to take LENGTH on all U/5 TWO TIMES. Also, take both lengths AND crown-rump lengths for all younger than 6 months.
For all U/5's, note if Kwashiorkor (KW) is evident: 0=NONE 1=MILD 2=SEVERE

ID NO.	NAME	STATURE (cm)	1=L,2=H	CR (cm)	WEIGHT (kg)	ARM (cm)	HEAD (cm)	SKINFOLD Triceps			SKINFOLDS Subscapular			SHIRT	KW	PREG. or BRFD?	DATE OF MEASURE
								1	2	3	1	2	3				

Source: Malawi Maternal and Child Nutrition Study

APPENDIX B (continued)

EXAMPLE OF ANTHROPOMETRY QUESTIONNAIRE

Date______________ Village______________ Enumerators: _________________________

Family Member	ID Number	Full Name	Male Female	Date of Birth	2=Card 1=Know 3=Guess	Exact Age	Height (cm)	Weight (cm)	Arm Circumference (kg)	Skin-fold	Vaccination 1=Polio 2=Measles 4=DPT
Father			M				a) b)	a) b)	a) b)	a) b)	
Mother or care giver			F				a) b) c)	a) b) c)	a) b) c)	a) b)	
Child							a) b) c)	a) b) c)	a) b) c)	a) b)	
Child							a) b) c)	a) b) c)	a) b) c)	a) b)	
Child							a) b) c)	a) b) c)	a) b) c)	a) b)	
Child							a) b) c)	a) b) c)	a) b) c)	a) c)	

(# children ever born to mother or care giver______) - (# children who have left us______) =
(# children still living______)

Are you pregnant? If YES: How many months?________
If NO: Do you have a child who is still breast feeding? ______

COMMENTS:____

(If any members are not home, where are they? When will they return? Tell them we will come back.)

Source: Southern Malawi Study, Harvard Institute for International Development.

APPENDIX B (continued)

ANTHROPOMETRIC TECHNIQUE CHECK LIST FOR MONITORING FIELD STAFF

Cluster: ____________________ Date: ___/___/___

Enumerators: ____________________ ____________________

	Enumerator:	
	#1	#2
I. Head Circumference		
Hats and other headgear have been removed	☐	☐
Hair is pressed against head	☐	☐
Tape in proper position over bump, level all around	☐	☐
Observer reads tape at the eye level of the CHILD	☐	☐
Reading correct and taken to the nearest 0.1 cm	☐	☐
II. Arm Circumference		
LEFT arm	☐	☐
When marking midpoint, arm is bent	☐	☐
Mark is made by one person while the other holds the tape	☐	☐
Mark is made at the BACK of the arm	☐	☐
When measurement is taken, arm is loose at the side	☐	☐
Observer is level with the CHILD when taking the measurement	☐	☐
Tape is not creased	☐	☐
Tape shows no air gaps and does not dent arm	☐	☐
Reading correct and taken to the nearest 0.1 cm	☐	☐
Tape placed in container after measurement is completed	☐	☐
III. Triceps Skinfold		
LEFT arm	☐	☐
Arm hanging loose by the side	☐	☐
Measurement taken on straight line through the elbow	☐	☐
Calipers placed directly on mid-point mark	☐	☐
Skinfold grasp 1 cm ABOVE calipers	☐	☐
Holds onto skinfold DURING measurement	☐	☐
Lets go of skinfold BETWEEN measurements	☐	☐
Reading correct and taken to nearest 0.5 mm	☐	☐
Verifies that means of 2 sets are with 2 mm	☐	☐
Places calipers in safe location after measuring	☐	☐
IV. Subscapular Skinfold		
Shirt is removed on children & men	☐	☐
Searches for bone with fingers before grasping skinfold	☐	☐
Grasps fold at 45% slant, 1 cm under bone	☐	☐
Back of subject is straight, not bent forward	☐	☐
Subject looking ahead, not over shoulder	☐	☐
Holds onto skinfold DURING measurement	☐	☐
Lets go of skinfold BETWEEN measurements	☐	☐
Reading correct and taken to nearest 0.5 mm	☐	☐
Verifies that means of 2 sets are with 2 mm	☐	☐
Places calipers in safe location after measuring	☐	☐

APPENDIX B (continued)

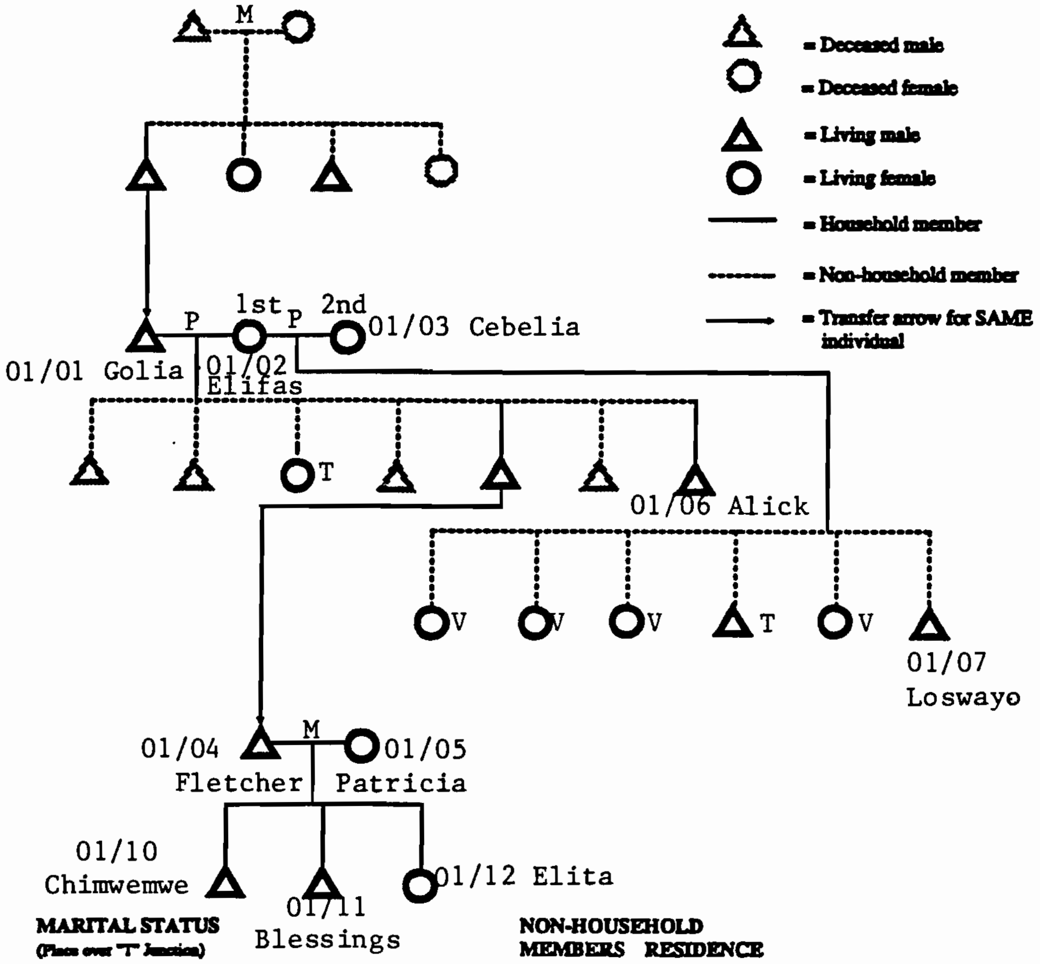
	Enumerator: #1	#2
V. Length of Under-fives		
Both team members work <u>together</u> placing child on board....		
Head & footwear are removed....		
One person lines up head, one holds knees & footpiece....		
Body of child is straight on board....		
Board firmly against heel when reading is taken....		
Footpiece is straight across when reading is taken....		
Reading correct and recorded to nearest 0.1 cm....		
VI. Weight of Under-fives using Salter Scale		
Bag is clean....		
Heavy clothes have been removed....		
Scale is standardized with EMPTY bag on it....		
Two people pick up child, one putting hands through holes....		
Are at eye level with scale when taking reading....		
No one touching child during actual reading of scale....		
VII. Adult Weight using SECA Scales		
Scale is standardized <u>before</u> leaving for interviews....		
Scale is placed on board on a FLAT surface....		
Scale is re-standardized using enumerator's weight....		
Observer is close to the dial when taking the actual reading....		
Reading correct and recorded to nearest 0.5		
Metal & wood piece placed in scale before packing....		
Scale transported in backpack, not on bike carrier....		
VIII. Height of Adults		
Height pole set up on flat surface....		
Footwear & headgear are removed....		
Subject stands on correct side....		
Knees of subject straight, feet against back of board....		
Shoulders straight back....		
Head straight, looking forward....		
Hair pressed down....		
Pencil used to make sure level reading is taken....		
Reading taken at eye level....		
Reading correct and recorded to nearest 0.1 cm....		
IX. General Observations		
Does the team set up the equipment in an organized fashion?....		
Do they ask each other for assistance when needed?....		
Do they record measurements as soon as they are taken?....		
Do they talk to and comfort the children who are afraid?....		

Source: Malawi Maternal and Child Nutrition Study.

APPENDIX C

FAMILY TREE: DIAGRAM OF FAMILY RELATIONSHIPS

An Example From the Paternal Side of a Household



MARITAL STATUS
(Place over "T" Junction)

S = Single
M = Married, Monogamous
P = Married, Polygamous
D = Divorced or Seperated

NON-HOUSEHOLD MEMBERS RESIDENCE
(Placed next to each individual circle or triangle)

P = Present in DIFFERENT HH on SAME compound
S = Away at school
V = Living in a village
T = Living in a town
C = Living in a city (BL, LIL, MZ)
AS = Living abroad in SOUTH AFRICA
A = Living abroad, not in South Africa

Source: Malawi Maternal and Child Nutrition Study.

Note: Each horizontal row represents a generation. Each individual member of the COMPOUND should be labeled with their name and HOUSEHOLD NO./ID NO. For example: Sarah Phiri 02/08.

APPENDIX D

EXAMPLE OF NUTRITIONAL KNOWLEDGE QUESTIONNAIRE

NUTRITIONAL KNOWLEDGE
Date:__/__/__
Interviewees:______________________________

HHID:________________
Enumerator No.:________

Survey No.: 06
ID No.:______

Supervisor: _____ __/__/__
Office:__________ __/__/__
Input: __________ __/__/__

1. Have you ever heard of the three food groups? YES NO

IF SO: Please give me an example from each of the three groups.
What does this food do for the body:

Example	Correct?	Purpose of this food?	Correct?
	Y N		Y N
	Y N		Y N
	Y N		Y N

IF NOT: What are some foods that are needed to make the child grow?

Protein mentioned?	Y	N
Carbohydrate mentioned?	Y	N
Vegetable mentioned?	Y	N

2. Do you know the name of this disease? (Show the picture of Kwashiorkor): The child does not grow well, hair has become reddish, his legs are swollen, and his skin is peeling off.

(Record Response of "Kwashiorkor," "Nthaka," "Chinyaunya," other, or don't know.)__________ Correct? Code:__________
How does this disease come about?____ Code:__________

3. Do you know the name of this disease (Show the picture of Marasmus): This child is not growing, he is very thin, his face looks like that of an old man and his hair is all straight.

(Record Response of "Marasmus" or "Nthumbilwa," other, or don't know.)____________________ Correct? Code:__________
How does this disease come about?____ Code:__________

4. When you are pregnant, do you need to eat less food, more food, or the same amount of food?
1 = less 2 = more 3 = the same amount

5. Is there anything that you are told not to eat when you are pregnant? YES NO

IF YES:
(a) What foods?____ Codes:____, ____, ____
(b) Who told you about these foods?________________________________ Code:____
(c) Why are they forbidden?______________________________________ Codes:____

Appendix D (continued)

Are there any foods that you stop eating besides these? YES NO

IF YES: Which are they?____________________ Codes: ____, ____, ____
Why?____________________ Codes: ____, ____, ____

6. What do you do when you find the child has diarrhea?____________________

____

(If the answer includes a mixture of sugar, salt, and water, inquire as to how much of each is used.)

1 - Completely correct
2 - Partially correct
3 - Wrong

7. What causes the child to have diarrhea?____________________ Correct? Code:________

8. Have you ever studied with or spoken to someone from one of the following organizations?

Community Development Assistant	Y N	Farm Home Instructor	Y N	Church Homecraft Center	Y N
Agricultural Training Center	Y N	Homecraft Worker	Y N	Other:____________	Y N

APPENDIX E

EXAMPLE OF A MORBIDITY QUESTIONNAIRE

Dist Cluster Vlg Compound Household IDNO Enum.___________ Round no.|__-__| Date |__-__|__-__|__-__|

Super:___ ___/___/___
Office:___ ___/___/___
Input:___ ___/___/___

___________Village____________ Name of Eldest_______________ IDNO Eldest |__|__|__|__|

		Symptom #1		Symptom #2		Symptom #3		Total	4.	5.	6.	7.	8. Types of Health Care Sought								9.
I.D. Number	First name	2. CODE	3. DAYS	2. CODE	3. DAYS	2. CODE	3. DAYS	Days Ill	Days Didn't Eat	Days Work Lost	Caregiver IDNO	Days Work Lost	Source 1	Treatment-1 Code	Code	Code	Source 1	Treatment-2 Code	Code	Code	Cost in Kwacha
		S1:		S2:		S3:															
		S1:		S2:		S3:															
		S1:		S2:		S3:															
		S1:		S2:		S3:															
		S1:		S2:		S3:															
		S1:		S2:		S3:															
		S1:		S2:		S3:															
		S1:		S2:		S3:															
		S1:		S2:		S3:															

YOU FILLED IN ANY SPACES ABOVE WITH CODE 97 FOR "OTHER-SPECIFY" USE THE SPACES BELOW TO FILL IN THE IDNO OF THE ILL PERSON AND THE ANSWER:

SYMPTOM CODE = 97: IDNO |__|__|__|__| Symptom ________________ IDNO |__|__|__|__| Symptom ___________
SOURCE OF CARE CODE = 97: IDNO |__|__|__|__| Source ________________ IDNO |__|__|__|__| Symptom ___________
TREATMENT CODE = 97: IDNO |__|__|__|__| Treatment ________________ IDNO |__|__|__|__| Symptom ___________

Source: Malawi Maternal and Child Nutrition Study.

APPENDIX E (continued)

QUESTIONS TO USE WITH MORBIDITY QUESTIONNAIRE

ALWAYS BRING THIS SHEET WITH YOU TO THE FIELD

1. Has anyone in this household fallen ill since our last visit?

   IF AN U/S IS PRESENT IN THE HH, PROBE!: Has the child suffered from diarrhea, cough, runny nose or fever since our last visit? How many times? How long did each bout last?

2. **(For columns headed Symptom #1, Symptom #2, Symptom #3: "CODE" section)**
   What were the symptoms of the illness?

3. **(For columns headed Symptom #1, Symptom #2, Symptom #3: "DAYS" section)**
   How long did each symptom last? **PROBE TO FIND OUT THE TOTAL NUMBER OF DAYS ILL! MORE THAN ONE SYMPTOM MAY HAVE OCCURRED ON THE SAME DAY—DO NOT JUST ADD THE NUMBERS OF DAYS FOR EACH SYMPTOM!!**

4. **(For column headed "Days Didn't Eat)**
   If the ill person (or child) did not continue to eat while ill, record the number of days the ill person did not eat.

5. **(For 1st column headed "Days Work Lost")**
   IF THE ILL PERSON IS AN ADULT: If the ill person did not go to work every day during his/her illness, how many days of work were lost?

6. **(For column headed "Caregiver IDNO")**
   Who in this household was primarily responsible for taking care of the ill person (child) while he/she was sick? **RECORD IDNO IF CAREGIVER IS MEMBER OF HOUSEHOLD— IF NOT, RECORD "9999"**

7. **(For 2nd column headed "Days Work Lost")**
   If the person caring for the sick person lost any workdays because he/she was looking after the ill one, how many days were lost?

8. **(For column headed "Types of Health Care Sought")**
   If the ill person sought any assistance outside the home,where did he or she go for help? What was the treatment?

9. **(For column headed "Cost in Kwacha")**
   If any money was spent seeking assistance or in treating the ill person, how much was spent?

   TOTAL COST - (TRANSPORTATION TO AND FROM PRACTITIONER/PHARMACY) +
   (COST OF CONSULTATION) + (MEDICINES, HERBS, ETC.)

Source: Malawi Maternal and Child Nutrition Study.

APPENDIX E (continued)

INSTRUCTIONS AND CODES FOR MORBIDITY QUESTIONNAIRE

BE SURE AND COMPLETE THE HEADING OF THE QUESTIONNAIRE BEFORE YOU GO TO THE INTERVIEW. Also, write the names and IDNO's of each family member in the grid before you go to the interview. That will help you remember to probe for illness for each family member.

YOU MUST TAKE THE "QUESTION" SHEET TO THE FIELD WITH YOU FOR EACH AND EVERY INTERVIEW! That way you will be able to easily remember the questions to ask.

TO WHOM DO WE ADMINISTER THE QUESTIONNAIRE? For a child, as the mother or primary caretaker for the symptoms. For adults ask the adult himself/herself.

1. Has anyone in the households fallen ill since our last visit? IF AN U/5 IS PRESENT IN THE HH: Has the child suffered from diarrhea, cough, runny nose, or fever since our last visit? How many times? How long did each bout last?

Be sure to probe for each type of illness for each U/5. Do not forget to probe for illnesses for adults, too.

IDNO In the first column, record the four-digit IDNO of each person who has been ill. The first two digits are the household ID, and the last two are the person's individual ID.

In the next column, write in the first name of the person who has been ill.

If the person was not ill, write "99" in the first two code boxes for (S1) and "9999" in the boxes on the far right of the page for "Cost in Kwacha." Connect these two sets of "99's" with a solid line. Refer to the example to see how this should be correctly filled out.

2. What were the symptoms of the illness? 3. How long did each symptom last? Not that there is a blank space marked "S:" under each column headed "Symptom." This is the space where you can write the words of the actual symptom. Then you may code it later.

There are spaces for three symptoms for each time a person was sick. Find the codes for these symptoms in the codebook, and write the numbers in the boxes. Also record the number of days each the person suffered with each symptom.

SPECIAL PROBLEM: What if the person had more than three symptoms? This is very rare. If this happens you must choose the three symptoms that are most serious. For example, suppose a person suffers from diarrhea, heachache, fever, and convulsions. "Headache" is the least serious symptom. Write the symptom codes for diarrhea, fever, and convulsions in the boxes for symptoms.

In the next column fill in the **Total Days Ill.** PROBE to find out the total number of days ill. More than one symptom may have occurred on the same day, so if you add up the number of days for each symptom to get the total, it will be wrong! For example, if a child had a cough for three days, a fever for three days, and an earache for three days, but it was the same three days for all symptoms, the **Total Days Ill** should be recorded as three. If you added up the number of days recorded for each symptom, it would look like the child was ill for nine days!

APPENDIX E (continued)

4. <u>If the ill person (or child) did not continue to eat while ill, how many days did he or she not eat?</u> Fill in the number of days in the column under "Days Didn't Eat." Round to the nearest number of whole days. If the ill person has any solid food at all during the day, they have eaten. If they drink only tea, etc., they have not eaten.

5. <u>FOR ADULTS: If the ill person lost any work days during his/her illness, how many days of work were lost?</u> Fill in number of days in the column "Days Work Lost." Round to the nearest number of whole days. "Work" means any work done off the compound, like fieldwork or work for money. In this case we do not count domestic work on the compound as "work."

6. <u>Who in the household was primarily responsible for taking care of the ill person (child) while he/she was sick?</u> In the column headed "Caregiver IDNO" fill in the four digit IDNO of the primary caregiver. If the primary caregiver is not a member of the household, fill in "9999." If <u>no one</u> took care of the sick person, fill in "0000."

7. <u>If the person caring for the sick person lost any work days because he/she was looking after the ill one, how many days were lost?</u> Fill in number of days in column headed "Days Work Lost." Round this number to the nearest number of whole days.

8. <u>If the ill person sought any assistance where did he or she go for help? What was the treatment?</u> This column is now divided into two basic sections: the first is for the <u>first</u> type of health care sought, and the second is for the <u>second</u> type of health care sought. Both sections are divided into a "Source" section and "Treatment" section. The "Source" section means the source of health care or assistance. This may be the person to whom the family member went for healing (such as Village Health Worker, sing'anga, etc.), or the place care was received. For example, the person may tell you they went to the clinic. These "Source" codes are in your codebook. The "Treatment" section is for what type of treatment the person actually received (such as injections, pills, herbs, etc.).

At the top of each "Source" and "Treatment" section is a blank box. Use this box to write the words of the "Source" and "Treatment" that the ill person used. Then you can code them correctly at a later time.

Ask the person (or caretaker) if they sought any assistance for the illness. Find out to whom or where they went for assistance and write the code in the box. Write the code for the first source in the "Source1" box and the code for the second source consulted in the "Source2" box. If only one person was consulted, write "99" in the "Source2" box. If no treatment was sought outside the household, use the code "00." After asking about the source of care, ask what treatment the person received. Write the codes for the treatment that was given after consulting the first person in the "Treatment-1" boxes. Write the codes for the treatment that was given after consulting the second person in the "Treatment-2" boxes. There are three sets of boxes underneath "Treatment-1," and three sets underneath "Treatment-2," so there is plenty of space to write each treatment. The codes for these sections are written in your codebook. If the person sought care but received no treatment, use the code "00" in the first space for a treatment code.

9. If any money was spent seeking assistance or in treating the ill person, how much was spent? The amount that was spent to help the person be well again is the total cost of the illness. Be sure to probe for all types of expenses that may have been related to the illness. **THE TOTAL COST OF THE ILLNESS INCLUDES:**

TRANSPORTATION COSTS (Any and all transportation costs related to the illness, such as to and from the clinic or sing'anga, pharmacy or store, etc.)

+

COST OF CONSULTATION (Cost of seeing the doctor, sing'anga, or any other practitioner)

+

COST OF ALL TREATMENTS (Cost of medicines, herbs, special foods that were bought, or any other item needed for treatment of the illness)

Include the cost of special foods <u>only</u> if these foods were bought for the ill person to help cure him or her.

Add all of these costs together and fill in the <u>total</u> cost of the illness in the last column, right-justifying your answers and using the decimal place correctly. For example, if a total if K7.53 was spent on the illness, enter this figure like this:

|_0_|_7_._5_|_3_|

APPENDIX E (continued)

CODES FOR MORBIDITY

2. What were the symptoms of the illness?
Symptom Codes (for columns S1, S2, and S3)

01-Fever
02-Diarrhea
03-Cough
04-Wasting, losing weight
05-Headache
06-Convulsions
07-Stomach pains
08-Weakness, fatigue, dizziness
09-Vomiting
10-General body and bone pain
11-Measles
12-Running ear, earache
13-Sore eyes
14-Boils, skin rashes
15-Lower abdominal pain and/or pain passing urine
17-Menstrual problems and/or vaginal discharge NOT related to pregnancy
18-"Side pains" or difficulty in breathing
19-Back pains and problems
20-Irritable, crying
21-Anemia, shortage of blood (USE THIS CODE ONLY IF THE WOMAN WAS TOLD THIS AT THE CLINIC)
22-Swelling
23-Rheumatism
24-Runny nose
30-Prenatal check-up: regular medical exam for pregnant woman
37-Problems due to pregnancy, for which there is no symptom code above
97-Other health problems not related to pregnancy-SPECIFY
99-Missing or NA

8. Did the ill person seek any assistance outside the home?
IF SO: Where did they go for help?

00-No treatment sought outside the household
01-Azamba--Traditional birth attendant with no training from Ministry of Health
02-Traditional birth attendant (TBA) with special training from Ministry of Health
03-Village Health Worker
04-Sing'anga
05-Person who gives injections
06-Local woman (not a midwife or village health worker) who gives advice and/or medicine
07-Local man (not a sing'anga or village health worker) who gives advice and/or medicine
08-Relative with no special training in healing, who lives in another household
09-Clinic in rural area, less than 5 kms away
10-Clinic in rural area, 5 km away or further
11-Clinic in district centre or city
12-Hospital
97-Other--SPECIFY
99-Missing or NA

What was the treatment?
Treatment Codes (For Treatment-1 and Treatment-2)

00-No treatment given
01-Herbs, local medicine or treatment
02-Pills
03-Injections
04-ORT (oral rehydration therapy)
97-Other--SPECIFY
99-Missing or NA

APPENDIX F

ANOTHER EXAMPLE OF A MORBIDITY QUESTIONNAIRE

I. CHILD MORBIDITY

Is the respondent the principal caretaker of one or more children 6 years old or under? (Circle one) YES NO ---> Skip this section

YES ---> Has your child been sick since my last visit?

<table>
<tr><th colspan="2">*** FILL OUT BEFORE THE INTERVIEW ***</th><th colspan="6">>>> PROMPT FOR EACH INDIVIDUAL SYMPTOM <<<</th></tr>
<tr><th>Child's ID code</th><th>Child's name</th><th>What symptoms did the child have?</th><th>Symptom Code</th><th>For how many days?</th><th>What did you do to relieve the child's pain?</th><th>Action Code</th><th>Where was the child treated?</th></tr>
<tr><td>|__|__|</td><td></td><td></td><td>|__|</td><td>|__|__|</td><td></td><td>|__|</td><td></td></tr>
<tr><td>|__|__|</td><td></td><td></td><td>|__|</td><td>|__|__|</td><td></td><td>|__|</td><td></td></tr>
<tr><td>|__|__|</td><td></td><td></td><td>|__|</td><td>|__|__|</td><td></td><td>|__|</td><td></td></tr>
<tr><td>|__|__|</td><td></td><td></td><td>|__|</td><td>|__|__|</td><td></td><td>|__|</td><td></td></tr>
<tr><td>|__|__|</td><td></td><td></td><td>|__|</td><td>|__|__|</td><td></td><td>|__|</td><td></td></tr>
<tr><td>|__|__|</td><td></td><td></td><td>|__|</td><td>|__|__|</td><td></td><td>|__|</td><td></td></tr>
</table>

NOTE: If the child was not sick, then fill "0" in the Symptom Code box. Make separate entries for different illnesses.

--------- SYMPTOMS -----------

0=no symptoms
1=malungo
2=diarrhoea
3=cough
4=diarrhoea & fever
5=cough & fever
6=fever
9=other

------------------------- ACTION TAKEN ---------------------------

1=nothing
2=gave home-made remedy
3=gave medicine from local healer
4=gave medicine bought from store
5=gave oral rehydration fluid
6=took to a dispensary (give name)
7=took to hospital (give name)
8=went to a midwife
9=other

Source: HIID Southern Malawi Study.

APPENDIX G

EXAMPLE OF FOOD FREQUENCY QUESTIONNAIRE

How often does the child eat the following foods?

Foods	more than once a day	almost everyday	at least 1/week	occas.
fish (any kind)				
chicken/meat				
cassava/potato				
green leaves				
beans (dry)				
groundnuts				
porridge (Phala)				
nsima				
sugar cane				
fruits				
egg				
milk				

Source: Nzungize, 1989.

APPENDIX H

AN EXAMPLE OF A WEIGHED DIETARY SURVEY FORM AT THE HOUSEHOLD AND INDIVIDUAL LEVEL

Family ID________ Today's Date |__|__|__| Enumerator____________

Child ID: _________

Child Birth: |__|__|__|

Circle One: Market Day
Sunday (if Christian)
Friday (if Muslim)
Holiday
Other

Small Scale:__
Large Scale:__

Child Sick? YES or NO

Symptoms:________________________

Number of Days Sick: ________

Mother ID: ____________

Description of UFA (maize flour) container: __________
Is container empty? YES or NO
Height(cm)______
Weight (g/oz.)_______|________

Symptoms: ____

Number of Days Sick: ________

Is mother breast-feeding? YES or NO

Is mother breast-feeding study child? YES or NO

If study child is breast-feeding, record beginning and ending of each breastfeeding session below:

Total number of breast-feeding sessions: _____

Enumerator's Opinion: ____

If you answered "no" to any question, explain:

1. Is study child eating the same types of foods as usual?	YES	NO
2. Is study child eating the same amounts of food as usual?	YES	NO
3. Is family eating the same types of foods as usual?	YES	NO
4. Is family eating the same amounts of foods as usual?	YES	NO

Recall child's diet from yesterday:

1. Morning meal
2. Midday meal
3. Evening meal
4. All snacks

Recall family's diet from yesterday:

1. morning meal
2. Midday meal
3. Evening meal
4. Types of snack foods eaten

List all snack foods eaten today by all family members other than the mother and study child:

____

____

Source: HIID Southern Malawi Study.

APPENDIX H (continued)

HIID MEAL PATTERN SURVEY

Midday Meal Eating Groups and the Weight of Each Group's Nsima Plate

eating group #	names of individuals	relationship to study child	sex	age	weight of plate plus nsima	weight of plate plus leftover nsima	weight of empty plate

Evening Meal Eating Groups and the Weight of Each Group's Nsima Plate

eating group #	names of individuals	relationship to study child	sex	age	weight of plate plus nsima	weight of plate plus leftover nsima	weight of empty plate

1) What reasons does the family give for dividing itself into these separate eating groups?

____

2) How does a parent know when a young child is ready to move from the mother's plate to another eating group?

____

3) At what age do young boys in this family move from their mother's plate to another plate? ______________
Who decides when a young boy is ready to move on to another plate? ______________

4) At what age do young girls in this family move from their mother's plate to another plate? ______________
Who decides when a young girl is ready to move on to another plate? ______________

5) Why do young boys move to their father's plate? ______________

APPENDIX H (continued)

HIID FAMILY ID: [ ][ ][ ]   ENUMERATOR: DATE:[ ][ ]/[ ][ ]/[ ][ ]

dish or snack name and ID code: [ ] [ ] [ ] [ ] | [ ] [ ] [ ] [ ]

	no	yes		no	yes
washed hands?	[ ]	[ ]	washed hands?	[ ]	[ ]
leftover dish?	[ ]	[ ]	leftover dish?	[ ]	[ ]
gift dish/snack?	[ ]	[ ]	gift dish/snack?	[ ]	[ ]
bought dish/snack	[ ]	[ ]	bought dish/snack	[ ]	[ ]

cook who prepared dish

weekly frequency of this dish: [ ][ ] | weekly frequency of this dish: [ ][ ]

time preparatn began to ended: [ ][ ] [ ][ ] [ ][ ] [ ][ ]

weight of empty pot

weight of cooked food | weight of cooked food

weight of pot plus food

weight of waste food | weight of waste food

weight of pot plus waste food

adults [ ]

children [ ]

list of ingredients

weight of plate plus raw ingredient

weight plate plus ingreds not cooked

weight ingreds to be cooked

origin [ ] [ ] [ ] [ ] [ ] | [ ] [ ] [ ] [ ] [ ]

weekly frequency [ ] [ ] [ ] [ ] [ ] | [ ] [ ] [ ] [ ] [ ]

APPENDIX H (continued)

HIID CHILD DIET FORM

Child's ID [ ][ ][ ][ ][ ] Child's Name Enumerator Date [ ][ ]/[ ][ ]/[ ][ ]

[ ] [ ] [ ] [ ]	[ ] [ ] [ ] [ ]	[ ] [ ] [ ] [ ]	[ ] [ ] [ ] [ ]	[ ] [ ] [ ] [ ]	[ ] [ ] [ ] [ ]	[ ] [ ] [ ] [ ]	[ ] [ ] [ ] [ ]	[ ] [ ] [ ] [ ]	[ ] [ ] [ ] [ ]	[ ] [ ] [ ] [ ]	name of prepared dish or snack food and ID code
											Raw/Cookd
											length x circumfer (L x C) of each snack
[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	how many snacks?
[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	yes gift
[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	not gift
[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	yes purch
[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	not purch
[ ][ ] [ ][ ] / [ ] [ ][ ] [ ] / [ ]	[ ][ ] [ ][ ] / [ ] [ ][ ] [ ] / [ ]	[ ][ ] [ ][ ] / [ ] [ ][ ] [ ] / [ ]	[ ][ ] [ ][ ] / [ ] [ ][ ] [ ] / [ ]	[ ][ ] [ ][ ] / [ ] [ ][ ] [ ] / [ ]	[ ][ ] [ ][ ] / [ ] [ ][ ] [ ] / [ ]	[ ][ ] [ ][ ] / [ ] [ ][ ] [ ] / [ ]	[ ][ ] [ ][ ] / [ ] [ ][ ] [ ] / [ ]	[ ][ ] [ ][ ] / [ ] [ ][ ] [ ] / [ ]	[ ][ ] [ ][ ] / [ ] [ ][ ] [ ] / [ ]	[ ][ ] [ ][ ] / [ ] [ ][ ] [ ] / [ ]	weight of empty plate
[ ][ ] [ ][ ] / [ ] [ ][ ] [ ] / [ ]	[ ][ ] [ ][ ] / [ ] [ ][ ] [ ] / [ ]	[ ][ ] [ ][ ] / [ ] [ ][ ] [ ] / [ ]	[ ][ ] [ ][ ] / [ ] [ ][ ] [ ] / [ ]	[ ][ ] [ ][ ] / [ ] [ ][ ] [ ] / [ ]	[ ][ ] [ ][ ] / [ ] [ ][ ] [ ] / [ ]	[ ][ ] [ ][ ] / [ ] [ ][ ] [ ] / [ ]	[ ][ ] [ ][ ] / [ ] [ ][ ] [ ] / [ ]	[ ][ ] [ ][ ] / [ ] [ ][ ] [ ] / [ ]	[ ][ ] [ ][ ] / [ ] [ ][ ] [ ] / [ ]	[ ][ ] [ ][ ] / [ ] [ ][ ] [ ] / [ ]	weight of plate plus cooked food
[ ][ ] [ ][ ] / [ ] [ ][ ] [ ] / [ ]	[ ][ ] [ ][ ] / [ ] [ ][ ] [ ] / [ ]	[ ][ ] [ ][ ] / [ ] [ ][ ] [ ] / [ ]	[ ][ ] [ ][ ] / [ ] [ ][ ] [ ] / [ ]	[ ][ ] [ ][ ] / [ ] [ ][ ] [ ] / [ ]	[ ][ ] [ ][ ] / [ ] [ ][ ] [ ] / [ ]	[ ][ ] [ ][ ] / [ ] [ ][ ] [ ] / [ ]	[ ][ ] [ ][ ] / [ ] [ ][ ] [ ] / [ ]	[ ][ ] [ ][ ] / [ ] [ ][ ] [ ] / [ ]	[ ][ ] [ ][ ] / [ ] [ ][ ] [ ] / [ ]	[ ][ ] [ ][ ] / [ ] [ ][ ] [ ] / [ ]	weight of plate plus waste food
											weight of food eaten
[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	yes wash
[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	no wash
[ ] [ ] [ ] [ ]	[ ] [ ] [ ] [ ]	[ ] [ ] [ ] [ ]	[ ] [ ] [ ] [ ]	[ ] [ ] [ ] [ ]	[ ] [ ] [ ] [ ]	[ ] [ ] [ ] [ ]	[ ] [ ] [ ] [ ]	[ ] [ ] [ ] [ ]	[ ] [ ] [ ] [ ]	[ ] [ ] [ ] [ ]	time of meal or snack

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