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MOVING FORWARD WITH COMPLEMENTARY FEEDING: INDICATORS AND RESEARCH PRIORITIES

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Abstract

For a number of reasons, progress in improving child feeding practices in the developing world has been remarkably slow. First, complementary feeding practices encompass a number of interrelated behaviors that need to be addressed simultaneously. Child feeding practices are also age-specific within narrow age ranges, which add to the complexity of developing recommendations and measuring responses. Finally, the lack of clear international recommendations for some aspects of complementary feeding has prevented the development of universal indicators to define optimal feeding. Without appropriate measurement tools, the design and evaluation of programs to improve complementary feeding practices cannot move forward.

The present paper is the first systematic attempt at filling this gap. It puts forth a framework for the development of indicators of complementary feeding practices and proposes a series of possible indicators to measure some of the most critical aspects of infant and young child feeding. The emphasis is on simple indicators for use in large surveys or in program contexts.

Indicators for the following aspects of complementary feeding of 6-23-month-old children are discussed: (1) breastfeeding; (2) energy from complementary foods; (3) nutrient density of complementary foods; and (4) safe preparation and storage of complementary foods. Finally, possible approaches to validate the proposed indicators are discussed and research priorities are highlighted.

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1. Introduction

Childhood malnutrition remains a major health problem in resource-poor communities, leading to excessive rates of morbidity and mortality, stunted growth, and impaired neurobehavioral development. Approximately one-third of children less than five years of age in developing countries have low height-for-age (<–2 SD with respect to reference data) (ACC/SCN 2000), and even larger proportions are deficient in one or more micronutrients. Causes of childhood malnutrition include intrauterine growth retardation (caused in large part by maternal undernutrition before and during pregnancy), poor child-feeding practices, and high rates of infections, all of which are conditioned by underlying poverty. Thus, integrated interventions addressing these multiple problems simultaneously are needed to reduce malnutrition and its associated complications.

Development of successful interventions to improve child-feeding practices, in particular, requires appropriate instruments to assess current feeding practices and monitor the impact of programs designed to improve them. During the past decade, simple, programmatically relevant indicators of breastfeeding practices have been developed to guide the planning, implementation, and evaluation of programs aimed at improving this component of child feeding. However, similar indicators to assess complementary feeding practices are still lacking. In response to this need, this paper puts forth a conceptual framework that could be applied to develop useful indicators for assessing complementary feeding. It then presents a series of possible indicators in relation to critical aspects of appropriate complementary feeding. Finally, it presents possible approaches to validate these indicators.

Definition and Importance of Complementary Feeding

In 1998, the World Health Organization (WHO) and UNICEF jointly published a document, *Complementary Feeding of Young Children in Developing Countries: A Review of Current Scientific Knowledge*" (Brown et al. 1998). This publication was

followed by a recent document titled: "Guiding principles for complementary feeding of the breastfed child" (PAHO/WHO 2003), which defines *complementary feeding* as "the process starting when breast milk alone is no longer sufficient to meet the nutritional requirements of infants, and therefore other foods and liquids are needed, along with breast milk" (p. 2). Any non-breast milk foods or nutritive liquids that are given to young children during this period are defined as *complementary foods*. These foods may be prepared specifically for children, or they may consist of family foods that are served both to children and to other household members.

Need for Programs to Promote Improved CF Practices

Limited data from many parts of the world indicate that complementary feeding practices are suboptimal from several perspectives. For example, in some cases complementary foods are introduced earlier than is desirable; in other cases their introduction is inappropriately delayed. The frequency and amounts of these foods that are offered may be less than required for normal growth, or their consistency or energy density may by inappropriate in relation to the child's needs. Information on the prevalence of specific micronutrient deficiencies further suggests that either the nutrient content of these foods is inadequate or nutrient absorption is impaired by other components of these foods. Frequent microbial contamination of complementary foods and the associated high rates of diarrheal disease also indicate a need for improved food safety. Finally, responsive feeding, maternal encouragement to eat, and other psychosocial aspects of care during feeding are likely to be important for ensuring adequate food and nutrient intake of the child.

Need for Child Feeding Assessment Tools in Program Development and Evaluation

Efforts to measure and quantify feeding practices have been hampered by methodological problems. Simple, valid, and reliable tools are lacking to measure child

feeding in the context of program development, for designing and targeting interventions, and for monitoring and evaluating progress.

The problem of measurement arises primarily because child feeding practices encompass a series of interrelated behaviors that are difficult to summarize into one or a few variables. Unlike exclusive breastfeeding, which can be summarized into one variable, measuring the quality of complementary feeding implies measurement of a variety of practices simultaneously. Child feeding practices are also age-specific within narrow ranges, which adds to the complexity of measurement. Finally, clear, international recommendations on some aspects of complementary feeding do not exist, which complicates the development of universal indicators and the selection of cutoff points to define optimal feeding.

2. Objectives and Organization of the Report

The main objectives of this report are to

➢ review and discuss possible indicators of adequate/optimal complementary feeding practices,

➢ describe steps in validating and assessing the utility of these potential indicators for various purposes.

The focus is on complementary feeding practices as they relate to children ages 6 to 23 months. Indicators of breastfeeding practices during the first six months of life have already been developed and are not reviewed here (WHO 1991).

The report is organized as follows. Section 3 presents a review of some general aspects of indicators and defines a list of criteria commonly used to assess their performance for different purposes. Section 4 briefly summarizes current complementary feeding recommendations and Section 5 presents a list of potential indicators of complementary feeding, emphasizing their strengths and limitations. Section 6 discusses

research needs and briefly describes potential approaches for validation of key indicators of complementary feeding.

3. Indicators: Characteristics and Performance Criteria

This section reviews several conceptual issues related to the development and selection of indicators for various purposes and describes criteria used to assess their performance. The issues reviewed are not unique to the area of complementary feeding, and the reader is referred to background materials for more information on these concepts in other contexts (Habicht and Pelletier 1990;WHO 1995).

Definition of Indicators

Indicators are data collected through measurement, observation, or interview that describe an underlying phenomenon. In many cases, the underlying phenomenon is unobservable—because it is not open to direct estimation, or it is too complex to estimate in a simple fashion. Such is the case with complementary feeding, which encompasses a variety of practices that are not easy to summarize. In this case indicators are required to characterize the usual dietary intake of the young child in order to evaluate its adequacy for maintaining health and supporting optimal growth and development.

Although methods to quantify amounts and nutrient composition of complementary foods exist, they are usually time- and resource-intensive, and they are subject to a variety of errors due to recall (when measurements are based on interviews) and to normal day-to-day variability in children's intake. For these reasons, researchers have focused on the development of indicators to capture behavioral practices that are believed to support adequate feeding of the infant and young child. These indicators are then used as "proxies" for adequate energy and nutrient content of the diet. This approach is well-developed for assessing infant feeding during the first six months of life, where, for example, a number of "proxy" practices are used to determine whether (a) the baby is put to the breast within the first hour following birth, (b) the baby is exclusively breastfed

and not given water or other prelacteal feeds, (c) the baby is fed on demand day and night, and (d) the baby is fed from both breasts.

This report reviews current knowledge and progress in developing similar types of indicators to capture the quality of feeding for the older infant and young child, i.e., 6–23 months of age, and proposes approaches to pursue the development of such indicators and areas for research.

Purposes of Indicators of Complementary Feeding

Indicators of complementary feeding are needed for the following purposes:

➢ For *assessment*: to describe current practices, collect baseline information, and/or make comparisons between programs, countries, regions, risk groups, etc.

➢ For *screening and targeting*: to identify vulnerable individuals, communities, or regions; make decisions about resource allocation; and target interventions to at-risk individuals and groups.

➢ For *monitoring and evaluation*: to monitor progress and demonstrate the impact of interventions designed to improve child feeding practices.

Complementary feeding indicators may also be useful for communication and advocacy purposes; for research to examine, for example, the associations between practices and outcomes; or to understand the constraints against or factors that might facilitate adoption of recommended practices.

For screening, targeting, or program monitoring and evaluation, indicators should be predictive of an individual's or a group's risk of short- or long-term outcomes, and should predict the likelihood that the individual or group will benefit from the intervention designed to change the underlying phenomenon captured by the indicator. It is thus important that indicators used for evaluation purposes be sensitive enough to reflect changes in this underlying phenomenon.

Performance Criteria of Indicators

Validity, Reliability, Random Error, and Systematic Bias

Indicators are usually evaluated with respect to two performance criteria: *validity* and *reliability* (Windsor et al. 1994). Validity addresses whether an indicator is really measuring what is intended, or whether it reflects the "truth" (or is accurate). Reliability refers to whether the results are "replicable," i.e., repeated measurements provide the same results. Other synonyms for reliability include *reproducibility* and *repeatability*. Table 1 lists key characteristics of indicators, common types of errors, and biases that may affect the validity and reliability of indicators (Kleinbaum, Kupper, and Morgenstern 1982; Rothman 1986).

Bias or *systematic error* is the main threat to validity because it results in an estimate that does not represent the truth. The most common type of bias occurs when practices are measured through interview techniques; this *recall bias* can result from systematic or voluntary misreporting of practices. Systematic falsification of responses tends to occur when interviewees are aware of what the "right" (or expected) answer is. This is a common problem in evaluations of education and behavior-change interventions because study participants may feel pressured to over-report the practices they have been taught during the intervention, even if they have not adopted them. Hygiene practices have been shown to be particularly subject to this type of recall bias, because most populations have at least a minimum knowledge and understanding of good hygiene, and thus they tend to over-report better practices (Curtis et al. 1993; Stanton et al. 1987).

A similar problem, which occurs when practices are measured through observation as opposed to recall methods, is *reactivity*. Reactivity refers to a situation where the individuals being observed modify their practices because of the presence of the observer. As described for recall methods, reactivity may result in an overestimate of the prevalence of good practices if individuals make a conscious effort to improve their practices in the presence of the observer. Reactivity may also lead to biases. For example, in the case of a study in the Philippines, caregivers stopped feeding their child during the

Table 1. Performance criteria for evaluating indicators

Term	Definition
	Key performance criteria for indicators
Validity	• Extent to which indicator measures the "truth" or the underlying concept it is thought to measure
	• Extent to which indicator is free of systematic error
Reliability	• Extent to which estimate is replicable or can be reproduced when measure is repeated, i.e., is free of imprecision, day-to-day variability (undependability), and systematic error
Responsiveness	• Ability of indicator to detect change when it occurs
	Main threats to validity and reliability (types of errors and biases)
Bias	• Also known as systematic error; main threat to validity; also affects reliability
	• *Consequence*: Biases results; estimate does not represent the truth (is not valid) and is not reliable
Random error (or imprecision)	• Variability in the measurement due to random factors such as random measurement errors, random recall errors, etc.; main threat to reliability
	• *Consequence*: Increases variance around the mean of the estimate, but does not affect the mean value itself. Does not affect validity or cause a bias, but reduces reliability; also affects sample size required
Intra-individual, day-to-day variability	• Variability within an individual from day to day (analogous to biologic variability)
	• *Consequence:* Reduces reliability of measurement; increases sample size requirements
Reactivity	• Applies to observations only; refers to individual modifying their behaviors because of the presence of the observer
	• *Consequence:* Affects both validity (causes bias) and reliability (measurement is not replicable)
	Misclassification measures
Sensitivity	• Proportion of individuals with the characteristic who were identified by the indicator as having the characteristic
Specificity	• Proportion of individuals not having the characteristic who were identified by the indicator as not having the characteristic
Positive predictive value	• Proportion of individuals identified as having the characteristic who truly have the characteristic
Negative predictive value	• Proportion of individuals identified not to have the characteristic who truly do not have the characteristic

period of observation because they could not offer foods to the observer (B. Daelmans, personal communication). Reactivity is highly culture-specific, and introduces systematic error, resulting usually in overestimates of good practices, but sometimes (as in the example above) in underestimates. Researchers have found, however, that reactivity

decreases rapidly after the first day of observation, and recommendations have been made to repeat the observations on one or more days and to discard the first day of observation (Gittelsohn et al. 1997). The present report focuses mainly on interview and recall methods, and thus the issue of reactivity will not be discussed further.

Random error results from a variety of "random" sources of error, as its name implies. Random error does not result in biased estimates, but it reduces the reliability of the measurement (i.e., the measurement has low replicability). There are two main sources of unreliability: (1) imprecision (random error in measurement, which can result both from intra-observer and inter-observer measurement error), and (2) undependability (random, nonnutritional factors that affect the measurement. The main source of undependability is normal day-to-day variability.) (Habicht, Yarbrough, and Martorell 1979).

When recall methods are used, random error may be due to poor memory or difficulties with the interview process and to other factors that may affect the ability of the interviewee to respond to the questions. In the measurement of feeding practices, the main source of unreliability is likely to be normal day-to-day variability. It is well recognized that individual food and nutrient intakes vary substantially from day to day, even in resource-poor settings (Piwoz et al. 1994; Nelson et al. 1989; Willett 1998b). Caregiver feeding practices also vary from day to day, in response to child illness, perceived appetite and growth, and a variety of caregiver factors such as time, resources, employment patterns, and beliefs.

Although day-to-day variability does not bias estimates, it is important to try to minimize it in order to increase reliability of the estimates (and reduce variability). There are two main approaches to minimizing day-to-day variability. First, if factors that increase the variability (instability) can be identified, data can be collected after stratifying on these factors. This will reduce the instability of the indicator. Second, repeating the measurements on multiple days (on each subject or a subsample) is another approach commonly used to increase the reliability of the indicator. This is typically done

in dietary surveys, in which data from multiple (independent) days of dietary intake are collected and averaged to capture the usual (mean) intake.

An alternative to this approach, which is often used when assessing behaviors, is to ask respondents to characterize their *typical* behavior or practice. For example, instead of asking the caregiver, "Who fed the child yesterday?," the question could be reformulated to ask, "Who *usually* feeds the child?" With regard to the collection of dietary data, food frequency questionnaires have been developed for this purpose. Typically, food frequency questionnaires aim to summarize frequency of intake of specific foods over a certain period of time. When evaluating such questionnaires, reliability is typically judged by assessing the reproducibility of the intake estimates from repeated administration of the questionnaire, and validity is assessed by comparing the intake estimates with usual nutrient intakes as measured during multiple days, using quantitative dietary recalls or records.

Sensitivity and Specificity

Other performance criteria used to assess and select indicators are sensitivity and specificity, which can be assessed only when a reference indicator (often referred to as a "gold standard") of the phenomenon of interest is available. The reference standard provides the "truth" against which the performance of an alternative indicator can be compared. This is the principle underlying the use of repeated recalls of dietary intakes as the reference standard of usual dietary intake on which the validity of a food frequency questionnaire can be judged.

Assessment of the sensitivity and specificity of an indicator allows an estimation of the level of misclassification that results from using the indicator. Perfect sensitivity implies that individuals with inadequate diets were so classified by the alternative indicator; perfect specificity implies that individuals with adequate diets were so classified by the indicator. Clearly, the higher the sensitivity and specificity, the less misclassification error present and the better the indicator; however, it is also true that

some errors may be more costly than others, considering the cost of missing individuals at risk or providing unnecessary services to those not at risk. It is the task of program planners and policymakers to decide how much and what type of misclassification error they are willing to tolerate in a given situation.

Application of Indicators

Several issues need to be considered when designing and using indicators of complementary feeding practices. Five such concerns are briefly described below.

Universal Versus Context-Specific

Although, generally speaking, the concept of optimal feeding practices can be applied universally, indicators to assess current status of infant feeding practices or progress toward improved behaviors may need to be operationalized locally, depending on specific contextual factors. By contrast with most breastfeeding indicators, which are universal in their formulation, many indicators of complementary feeding will need to be developed locally, because they depend on the specific practices of the target population or on locally available foods. For example, although cereal-based porridges are a main complementary food in many cultures, the ingredients and the method of preparation (i.e., whether fermentation or germination is used) need to be known, as well as the usual consistency of the porridge, before designing locally relevant indicators of complementary feeding practices. Another example is the use of fortified complementary foods. Although one potential way to assess the quality of young children's diet is to ask about intake of fortified processed complementary foods, the specific question asked must be adapted to the context where it is used. For example, in Guatemala, the question would be whether the child consumes the locally produced complementary foods *Incaparina* or *Bienestarina,* whereas in Ghana the question would refer to the use of *Weanimix*. Similarly, if the main source of energy of young children is a traditional porridge, information on the ingredients and preparation will be required.

Population Versus Individual

Indicators can be used to *make inferences* about individuals or groups of individuals. This distinction is important, because the level of precision (lack of random error) required to make inferences at the individual level is much greater than it is for making inferences at the population level. When making inferences about groups (or at the population level), it is still possible to derive unbiased estimates of the underlying phenomena of interest as it pertains to a group, even if individual values in the distribution are measured with error or are inherently unstable. For most evaluation purposes, the ability to make inferences at the population level will suffice. However, often a secondary use of such data is for etiological research in which the association between, for example, individual child feeding patterns and growth, is of interest. For examining individual-level associations such as these, more precise estimates are required, and thus methods to reduce random error in measurement of feeding practices need to be carefully applied.

Need For Age-Specific Indicators

As described earlier, optimal feeding of the infant and young child changes rapidly during the first two years of life; thus, indicators must be flexible enough to capture feeding practices at each stage. The key recommendation for the first six months is exclusive breastfeeding. After six months, however, it is expected that the infant will start receiving complementary foods, which will be introduced gradually into the diet. By the age of nine months, it is expected that the child will be receiving a variety of complementary foods, including animal products and micronutrient-rich foods. As the contribution of complementary foods to the child's energy and nutrient intake increases, the optimal frequency of feeding, as well as the quantity and variety of foods, are expected to increase. Clearly, indicators will not only have to be context-specific but also age-specific within each contextual setting.

Assessment of Current Versus Past Behaviors

In selecting a timeframe for recording information on feeding practices, one has to consider both accuracy and representativeness of the information. For instance, the 24-hour recall method, the most widely used time period for collecting dietary information, may be less prone to memory errors than longer periods; on the other hand, it is likely to be less representative of *usual* practices or intakes. This is true for dietary assessment methods used with both children and adults. An additional complexity of measuring young infants' dietary patterns, however, is that feeding practices tend to vary widely within short periods of time. Studies that compared 24-hour with 7-day recall of feeding practices (Arimond and Ruel 2003) or monthly reports of *usual* practices (Piwoz et al. 1995) or longitudinal methods (Zohoori, Popkin, and Fernandez 1993; Aarts et al. 2000) show wide discrepancies between measurement approaches. As expected, the one-day recall consistently overestimates exclusive breastfeeding rates. The main explanation for these discrepancies is that the movement from exclusive breastfeeding to mixed feeding and to the family diet does not follow a unidirectional, consistent pathway. Both maternal and child factors influence child feeding decisions, and these decisions are reversible within short periods of time (Marquis et al. 1998). Thus, the length of the recall period affects the estimated prevalence of feeding practices because of the true fluidity of these practices during early infancy and the rapid changes occurring when caregivers move in and out of certain practices. Consistency in the length of the recall period is therefore important if comparisons are to be made between programs, regions, or countries. The same issues apply to complementary feeding practices, but research findings currently available relate to breastfeeding.

In addition to the true variability in feeding practices, memory and recall errors may also affect prevalence estimates assessed from different lengths of recall. A study in Southern Brazil showed that the magnitude of misclassification of breastfeeding duration increased with time (Huttly et al. 1990). Compared with responses given when their infant was 11 months, 24 percent and 30 percent of mothers misclassified the duration of

breastfeeding when interviewed after the child completed 23 and 47 months, respectively. A systematic bias toward reporting longer durations of breastfeeding was observed among wealthier and more educated mothers.

Thus, the length of recall for reporting infant and child feeding practices should be standardized to ensure comparability between assessments. Estimates of early infant feeding practices derived from interviews involving widely different lengths of recalls between mothers of children of different ages (for example, all children under three or five years of age) should be avoided because recall periods longer than 12 months or so are unlikely to provide accurate estimates.

Single Indicators Versus Composite Indices

One of the goals of utilizing indicators is to communicate with policymakers and program planners regarding program impact and progress toward achieving policy goals. Given the multiplicity of indicators involved in the assessment of infant feeding practices, and the need for age-specific indicators, it is often difficult to summarize the information on infant and child feeding practices in an appealing and meaningful way. Composite child feeding indices have the potential to address some of these constraints and to provide useful information, particularly for advocacy and communication. In particular, indices can be made age-specific and they can include various dimensions of feeding practices (Ruel and Menon 2002). Composite indices can also be useful to detect associations between practices and outcomes when some cluster of optimal practices— rather than any single practice—is necessary to achieve benefits of detectable magnitude (Arimond and Ruel 2001). For example, appropriate timing of introduction of complementary foods is not sufficient to ensure that the child meets his or her daily nutrient requirements. As will be described in Section 4, complementary foods must have the right energy and nutrient density and be provided with sufficient frequency to respond to children's needs at different ages. Thus, some cluster of key practices (rather than any

individual practice) may be necessary for positive child outcomes, and these practices may be better reflected by summary scales or indices than individually.

Indices can also be useful to capture the underlying concept of "optimal feeding practices," which is of key importance for programmatic and policy initiatives. To be used for this purpose, however, indices have to be derived from existing recommendations for optimal feeding practices. As will be highlighted in the following section, specific, operational recommendations applicable to all contexts do not currently exist for many of the dimensions of infant and child feeding. Moreover, even for those dimensions for which recommendations do exist (e.g., the recommended amount of specific micronutrients that should come from complementary foods at different ages), the lack of simple tools to measure them requires the use of imperfect proxy measures. To continue with this example, it may be possible to use dietary diversity (number of foods or food groups consumed) as a proxy for micronutrient content of the diet. However, in the absence of context-specific validation studies, it is impossible to determine what would be the "optimal" dietary diversity that would allow children of different ages to meet their micronutrient requirements.

The present report focuses on identifying a set of individual indicators of complementary feeding practices. For additional discussion on the potential use of composite indices, see Ruel and Menon (2002); Arimond and Ruel (2001); (Arimond and Ruel 2003).

Measurement Approaches (Observation Versus Recall)

Information on child feeding practices can be collected by recall or by observation. The issue of the length of recall and the errors associated with recall methods when measuring dietary patterns or complex behaviors such as child feeding practices were highlighted previously. Scientists have long been uncomfortable with the degree of error inherent in such self-reported measures and have turned to observational methods for the measurement of specific practices thought to be particularly prone to

recall biases. As indicated earlier, recall methods are strongly discouraged for the measurement of hygiene practices because of the well-documented problem of systematic over-reporting of good practices. Structured observations have therefore become the method of choice for measuring hygiene practices. Observational methods, however, tend to be time and resource-intensive and subject to reactivity (people modifying their behavior because of the presence of an observer). Spot-check observations, a faster and less intrusive alternative to structured observations, have recently gained popularity for the measurement of hygiene practices (Ruel and Arimond 2002). This method, which consists of observing a list of predetermined conditions at one point in time during a home visit, seems to be less reactive, although it is equally subject to day-to-day variability. To our knowledge, spot check observations have not yet been developed for measuring other aspects of childcare and feeding practices. They are also likely to be of limited usefulness for the measurement of hygiene during food preparation and feeding, because they are designed to measure the consequences of behaviors (such as caregivers' hands clean/dirty; compound swept/unswept), rather than the behaviors themselves (caregiver washing her hands or sweeping the floor).

Child feeding practices are typically assessed by report or recall, and the limitations of the methods for this purpose were summarized in earlier. Validation studies are required to better document the strengths and limitations of these methods for measuring feeding practices and approaches to minimize recall biases and errors have to be pursued.

Experience with the measurement of psychosocial aspects of child feeding, such as maternal encouragement to eat and other aspects of caregiver-child interaction during feeding, is limited. Most studies to date have used structured observations to describe these complex interactions. Scales have been developed but most have not been validated (Bentley et al. 1991b; Engle and Zeitlin 1996; Gittelsohn et al. 1998; Guldan et al. 1993). Experience with survey approaches is extremely scarce, and it is probable that many aspects of psychosocial care will never be amenable to survey approaches (Arimond and Ruel 2001).

Validation of Indicators

As described above, to be useful, an indicator must be valid, i.e., it must measure the underlying construct it was designed to measure. For example, if the purpose of the indicator were to describe feeding frequency (or the number of times a sample of caregivers fed their child complementary foods yesterday), a valid indicator would— when compared to some measure of truth such as observation of feeding frequency over the previous 24 hours—correctly classify each caregiver/child pair in the right feeding-frequency category. In the absence of perfection, some caregivers would be misclassified, and thus the question of validity becomes one of "tolerable misclassification." In other words, the indicator is considered valid if it results in a tolerable level of misclassification for its intended use in a particular context.

Validation in Relation to Recommended Practices (e.g., RDA, Ideal Feeding Behavior)

In addition to considering the validity of indicators for measuring specific behavioral variables, a broader validity question that arises with complementary feeding is whether the set of optimal feeding practices measured can accurately predict nutrient adequacy. In other words, does the set of optimal practices adequately reflect nutrient adequacy or guarantee that an individual meets his or her estimated daily requirements?

In Relation to Health Outcome (e.g., Growth, Cognitive Development, Morbidity, Mortality)

In the last few decades, it has been important to examine the "functional validity" of nutritional indicators by assessing the degree to which variation in the indicator reflects underlying differences in the performance, health, and survival of the target population. For example, do children fed according to recommendations, as measured by a series of indicators, grow better? Are their developmental outcomes "better" than children who are not optimally fed? Such analyses have proven useful for motivating

concern for change among policymakers, but they do not assess the validity of the indicator itself and are therefore not recommended for this purpose.

4. Review of Recommended Complementary Feeding Practices (Universal Recommendations)

The WHO/UNICEF document on complementary feeding that was published in 1998 used a simple, consistent conceptual framework to establish energy and nutrient requirements from complementary foods (Brown, Dewey, and Allen 1998). These requirements were based on the difference between young children's estimated total energy and nutrient requirements and the amounts of energy and nutrients transferred in breast milk to children of different ages. Guidelines published in that document have been updated recently, based on newly available information on children's total energy and nutrient requirements. The current recommendations are reviewed briefly in the following sections, for each of three age groups: 6–8, 9–11, and 12–23 months. These recommendations address each of the following key aspects of complementary feeding: (1) the age of introduction of complementary foods and optimal duration of breastfeeding, (2) the energy required from complementary foods (and related recommendations concerning feeding frequency, food amounts, and energy density of these foods), (3) the amounts of nutrients required from complementary foods, (4) the appropriate consistency of these foods, (5) safe storage and preparation of complementary foods, and (6) care during feeding.

Duration of Exclusive Breastfeeding and Continued Breastfeeding

The latest expert consultation on duration of exclusive breastfeeding (WHO 2002) recommends exclusive breastfeeding for six months, with introduction of complementary foods and continued breastfeeding thereafter. Maintenance of frequent, on-demand breastfeeding until two years or beyond is also recommended.

Energy Required From Complementary Foods

New information is available on the total daily energy expenditure and body composition of healthy children, based on longitudinal observations carried out in the United States. These data have been adapted recently by a WHO/FAO/UNU expert committee to establish revised estimates of young children's total daily energy requirements. Based on this new information, estimates of the amount of energy required from complementary foods have been recalculated for children of different ages who consume average amounts of breast milk. In particular, the recommended levels of energy intake from complementary foods for infants with average breast milk intake in developing countries are about 200 kcal/d for infants 6–8 months of age, 300 kcal/d for infants 9–11 months of age, and 550 kcal/d for children 12–23 months of age (Dewey and Brown 2003). These recommendations assume good maternal nutritional status and adequate breast milk volume and composition.

Because of the difficulty in communicating specific amounts of food energy, practical recommendations for complementary feeding are generally stated in terms of the desirable feeding frequency, amount of food to be offered per feeding episode, and mean energy density of these foods. The latter is often expressed in terms of the types of foods (e.g., thick porridge) that might have the recommended level of energy density. Based on the revised estimates of energy needs from complementary foods described above, recommendations on the desired feeding frequency were also modified in relation to different possible levels of energy density of these foods (and vice versa). To develop feeding guidelines for the general population, information on children with low energy intake from breast milk was used, as these provide the most conservative assumptions regarding the minimum desirable number of meals or energy density of complementary foods needed to ensure adequate total energy intake. Based on these estimates, revised recommendations have been formulated (PAHO/WHO 2003). For the average healthy breastfed infant and young child with average energy density from complementary foods of at least 0.8 kcal/g, it is recommended that meals of complementary foods be fed 2–3

times per day at 6–8 months of age, 3–4 times per day at 9–11 months of age, and 3–4 times per day at 12–23 months of age.

Recommendations also state that older infants and young children should be provided additional "nutritious snacks[1] (such as a piece of fruit or bread or chapatti with nut paste) offered 1–2 times per day, as desired"; and that "if energy density or amount of food per meal is low, or the child is no longer breastfed, more frequent meals may be required" (PAHO/WHO 2003).

Note that previous recommendations for children 12–23 months of age were to feed complementary foods 4–5 times per day. It is currently believed, however, that high meal frequency may lead to excessive displacement of breast milk; for this reason, the revised recommendation limits the number of feedings to a maximum of four, even among children in their second year of life. It is thus important to confirm that energy density of the diet is 0.8 kcal/g or higher in this age group to ensure that they receive sufficient energy from complementary foods.

Nutrient Density

It is equally important to ensure that children meet their micronutrient requirements from a combination of complementary foods and breast milk. As indicated above, nutrient requirements from complementary foods have been estimated as the difference between young children's estimated total nutrient needs and the amounts transferred in breast milk to children of different ages (Brown, Dewey, and Allen 1998). The recommended nutrient intakes from complementary foods have been further expressed as nutrient densities, by dividing the amounts required from complementary foods by the amount of energy needed from these foods at each age. These recommended nutrient densities have also been updated recently, using newly available information on estimated energy and nutrient requirements of young children (Dewey and Brown 2003).

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1 Snacks are defined as foods eaten between meals—usually self-fed, convenient, and easy to prepare (PAHO/WHO 2003).

A summary of the recommended total daily nutrient intakes and nutrient densities of complementary foods is presented by age group in Table 2.

Table 2. Recommended total daily nutrient intakes and nutrient densities (per 100 kcal) of complementary foods, by age group[a] (Dewey and Brown 2003)

Nutrient	Recommended nutrient intake per day, by age group (months)			Recommended nutrient density of complementary foods per 100 kcal, by age group (months)		
	6–8	9–11	12–23	6–8	9–11	12–23
Vitamin A (µg RE/d or per 100 kcal)	400	400	400	31	30	23
Folate (µg/d or per 100 kcal)	80	80	160	11	9	21
Niacin (mg/d or per 100 kcal)	4	4	6	1.5	1.0	0.9
Pantothenic acid (mg/d or per 100 kcal)	1.8	1.8	2.0	0.29	0.23	0.18
Riboflavin (mg/d or per 100 kcal)	0.4	0.4	0.5	0.08	0.06	0.06
Thiamin (mg/d or per 100 kcal)	0.3	0.3	0.5	0.08	0.06	0.07
Vitamin B_6 (mg/d or per 100 kcal)	0.3	0.3	0.5	0.12	0.06	0.08
Vitamin B_{12} (ng/d or per 100 kcal)	0.5	0.5	0.9	0.08	0.03	0.07
Vitamin C (mg/d or per 100 kcal)	30	30	30	1.5	1.7	1.5
Vitamin D (µg/d or per 100 kcal)	5	5	5	2.3	1.5	0.9
Vitamin K (µg/d or per 100 kcal)	10	10	15	4.2	2.8	2.5
Calcium (mg/d or per 100 kcal)	400	400	500	105	74	63
Iodine (µg/d or per 100 kcal)	90	90	90	7.9	7.2	5.4
Iron (mg/d or per 100 kcal)	9.3	9.3	5.8	4.5	3.0	1.0
Magnesium (mg/d or per 100 kcal)	54	54	60	15	11	7
Selenium (µg/d or per 100 kcal)	10	10	17	0	0	1.1
Zinc (mg/d or per 100 kcal)	4.1	4.1	4.1	1.6	1.1	0.6

[a] Estimates assume average breast milk intake.

Appropriate Consistency for Age (Special Foods Versus Family Foods)

Children's ability to chew and swallow different physical forms of food, especially foods of thick or solid consistency, varies with age. In general, infants 6–11 months of age need soft, mashed (low viscosity) foods, whereas older children can cope with the same solid foods consumed by other members of the family. By approximately eight months of age, children can also start eating some "finger foods" (foods that the child can eat alone).

Safe Preparation and Storage of Complementary Foods

To interrupt transmission of potential pathogens through food or infant feeding, a number of specific behaviors are recommended. First, the individuals preparing and serving food (including the child) should wash hands thoroughly before food preparation and handling. Secondly, food should be served immediately after preparation and stored safely. Third, clean utensils should be used to prepare and serve food. Fourth clean cups and bowls should be used when feeding children. And finally, feeding bottles should be avoided because they are difficult to keep clean (PAHO/WHO 2003). Additional food safety tips are provided by WHO in *Five keys to safer food* (WHO 2001), as follows:

1. *Keep clean*: wash hands and maintain kitchen area and utensils clean.
2. *Separate raw and cooked*: keep raw meat in particular separate from other foods consumed raw.
3. *Cook thoroughly*: (especially meat, eggs, seafood); cook foods to a temperature of 70°C; reheat cooked food thoroughly.
4. *Keep food at safe temperatures*: do not leave cooled food at room temperature for more than two hours; store food at temperatures above 60°C or below 5°C; do not store food too long, even refrigerated; do not thaw frozen food at room temperature.
5. *Use safe water and raw materials*: use safe water or treat it; select fresh foods; choose foods processed for safety (e.g., pasteurized milk); wash fruits and vegetables.

Care During Feeding

Increasingly it is recognized that, in addition to the dietary aspects of feeding, caregiver-child interactions during feeding may critically influence nutrient intakes. Although such interactions are repeated, complex, and variable, feeding behaviors often occur together in ways that can be conceptualized as a caregiver "feeding style."

In the literature, three feeding styles have been conceptualized: controlling, laissez-faire, and responsive (Birch and Fisher 1995; Bentley 1999). In a controlling style of feeding, the caregiver seeks to control when and how much the child eats; this may result in either forced feeding or dietary restriction. It has been theorized that children learning to eat in an environment characterized by a controlling style of feeding do not learn to recognize their appetite cues and self-regulate their energy intake, and that ultimately such children are at risk of becoming overweight (Birch and Fisher 2000; Black et al. 2001).

At the other end of the spectrum is the laissez-faire style of feeding, in which the caregiver provides little physical help or verbal encouragement to eat, even to children less than one year of age. In general, this style of feeding does not reflect neglect, but rather stems from parental and cultural beliefs that support minimal caretaker-child interaction during feeding, including beliefs that the child should determine when and how much to eat, that a child knows his or her own limits, or that learning to self feed builds resilience (Dettwyler 1989a; Zeitlin 1996; Engle and Zeitlin 1996; Bentley 1999). Laissez-faire or passive styles of feeding have been documented in diverse cultural settings in developing countries and have been hypothesized to contribute substantially to growth faltering in children 6–24 months of age, especially when combined with an environment in which children are frequently ill, with its associated anorexia (Dettwyler 1989b; Bentley et al. 1991b).

The third style of feeding, termed "responsive," includes such behaviors as physically helping the young child to eat, verbal encouragement and prompting, role playing, persistence and patience, offering additional spoonfuls or bites, monitoring of child cues of appetite and satiation, and a variety of other strategies that improve dietary intakes.

An accumulating body of evidence links laissez-faire feeding to lower dietary intakes and anthropometric status, and controlling feeding to excess energy intake and overweight, leading to the argument that responsive feeding represents an optimal style to support the short- and long-term growth and development of young children (Bentley et

al. 1991b; Engle and Zeitlin 1996; Klesges et al. 1991; Birch and Fisher 2000). For this reason, it is recommended that responsive feeding should be practiced.

Responsive feeding fits well within the principles of psychosocial care (Engle, Bentley, and Pelto 2000; Pelto, Levitt, and Thairu 2002). Three principles of psychosocial care apply to optimal feeding: (a) perceive and interpret accurately the child's signals regarding hunger and satiety; (b) respond adequately and promptly; (c) use "scaffolding" in interactions. "Scaffolding" describes a learning process in which a caregiver observes and builds on a child's abilities and skills, responds to various cues from the child, provides support when necessary, and gradually releases responsibility for the accomplishment of the task, in this case, eating.

As stated in a recent document describing "Guiding Principles for Breastfeeding and Complementary Feeding" (PAHO/WHO 2003), optimal caregiver-child interactions during feeding should include: (a) feeding infants and assisting older children when they feed themselves, being responsive to their hunger and satiety cues; (b) feeding slowly and patiently, and encouraging children to eat, but without forcing them; (c) experimenting with different food combinations, tastes, textures and methods of encouragement when children refuse to eat; (d) minimizing distractions during meals; (e) talking to children during feeding, with eye to eye contact, recognizing that feeding times are periods of learning and love.

It should be recognized that successful programs to improve the feeding of infants and young children have long recognized the need to educate and motivate caregivers on feeding behaviors in order to accomplish feeding goals (Bentley, Black, and Hurtado 1996; Caulfield, Huffman, and Piwoz 1999). Although there is some consensus on how children should be fed and the key feeding behaviors or strategies that support the paradigm of responsive feeding and the importance of psychosocial care, there is a paucity of research demonstrating that such behaviors can be changed, or documenting that such changes influence the dietary intakes or health and nutrition outcomes or young children. More research in this area is urgently needed.

5. Possible Indicators of Adequacy of Recommended Practices

In this section, we present a series of possible indicators of adequate complementary feeding practices in relation to the key aspects of complementary feeding discussed above. In each case, we first discuss *ideal* indicators and measurement approaches, that is, those that presumably provide accurate and valid information on the particular aspect of complementary feeding, although the intensity of data collection may render them impractical for large-scale programmatic use. We then propose alternative proxy indicators that might be applied to approximate the same information, but are easier to collect and therefore potentially more feasible for routine use. These alternative indicators, however, may be less precise (have more random error), and their performance may need to be evaluated in different contexts and for different purposes.

Table 3 summarizes proposed population indicators for the different aspects of child feeding discussed in this report for breastfed, 6- to 23-month-old children. Emphasis is placed throughout this report on defining population-level, as opposed to individual-level, indicators. As indicated earlier, these levels refer to those at which inferences can be made, as opposed to the level at which data are collected. For instance, many of the population-level indicators proposed in Table 3, require data collection at the individual level. However, in most cases, they should not be used to make inferences at the child level, but rather, should be used for group- or population-level inferences only.

Table 3 also summarizes current age-specific recommendations for each practice reviewed, based on the "Guiding Principles"(PAHO/WHO 2003), identifies the individual-level type of information required to derive the indicators, proposes data collection approaches, and provides examples of questions that can be used to guide data collection. Note that the questions listed should be used merely as a guide and should not replace the development of locally relevant and culturally appropriate interview questions.

Table 3. Suggested indicators for measuring complementary feeding practices among children ages 6–24 months

Feeding Practice	Recommendation/ Guiding Principle[a]	Child-level Information needed	Data collection approach	Comments, issues to consider	Examples of questions[b]	Population-level indicator
CONTINUED BREASTFEEDING (BF)						
Continued BF	Continue frequent, on-demand BF until 2 years of age or beyond	➢ BF (y/n) ➢ Frequency -daytime -nighttime	24-hour recall[c]	How should information on feeding frequency be collected and interpreted?	1. Did you breastfeed the child yesterday? Or do you currently breastfeed child? 2. How many times did you breastfeed child during the day—during the night? (Codes should include number of times and code for "on demand.")	*From data collected at child level:* ➢ % 6–23 mo. children BF yesterday: indicator can also be derived for smaller age groups, assuming appropriate sample size (e.g., 6-11, 12-17, 18-23, etc.) ➢ % children BF yesterday at least minimum number of times for age (minimum to be determined) ➢ % 6–23 mo. children BF "on demand" (according to local definition)
ENERGY FROM COMPLEMENTARY FOODS (CF)						
a) Energy density (community/ group level indicator; locally defined)	Average energy density should be ≥ 0.8 kcal/g	➢ Average energy density of main sources of energy (porridge or gruel)	*Group/ Community level:* 1) Group recipe trials to identify main sources of energy at different ages, measure ingredients used in preparations; or 2) recall to gather information on recipes	Information is then used to derive energy density (and nutrient density) of main CF, using food composition tables.	*Group/community level:* 1) Group recipe trials (see method, Section 5, page 36) 2) Recall: 1. What is the main food (porridge or other) that caregivers usually feed children [_] mo. in this community? 2. How is this food usually prepared? (Need to collect information on recipes and amounts derived from recipes)	*From data collected at group/community level:* ➢ Average energy density of main sources of energy for children of different age groups.

Feeding Practice	Recommendation/ Guiding Principle[a]	Child-level Information needed	Data collection approach	Comments, issues to consider	Examples of questions[b]	Population-level indicator
b) Feeding (meal) frequency	Recommended frequency of feeding CF are: 2-3 times: 6-8 mo. old 3-4 times: 9-11 mo. 3-4 times: 12-23 mo. In addition, 1-2 nutritious snacks should be provided.	➤ Number of times child fed meals of CF yesterday (each CF or any CF) ➤ Number of times child fed snacks yesterday	24-hour recall	Need to define feeding episode; Need to distinguish between meals and snacks; Need to develop approach to elicit accurate information.	How many times did you feed the child CF yesterday (using local examples)?; How many times did you feed the child snacks (using local name and examples of typical snacks in this population)? Alternative: Use a step-by-step series of questions to help recall feeding events of previous day.	*From data collected at child level:* ➤ % 6-8 mo. old children fed CF at least 2 times in past 24 hours ➤ % 9-11 mo. old children fed CF at least 3 times in last 24 hours ➤ % 12-23 mo. old children fed CF at least 3 times in last 24 hours ➤ % 6-23 mo. old children fed snacks at least 1 time in last 24 hours *Note: indicators to be used only if average energy density of diet ≥ 0.8 kcal/g*
NUTRIENTS FROM COMPLEMENTARY FOODS						
Nutrient density (dietary quality)	Feed a variety of foods to ensure nutrient needs are met. Meat, poultry, fish, or eggs should be eaten daily, or as often as possible. Vegetarian diets cannot meet needs unless supplements or fortified products are used. Vitamin-A rich fruits and vegetables should be eaten daily. Provide diets with adequate fat content. Use fortified CF or vitamin-mineral supplements for infant, as needed.	➤ Child energy and nutrient intake; or intake of list of foods (y/n); or of list of food groups (y/n)	Alternative approaches (by descending order of precision of estimates): 1. Quantitative 24-hour recall 2. Food frequency (selected foods) 3. Number of foods or food groups (dietary diversity (DD)) 4. Intake of pre-selected foods or food groups	24-hour recalls Food frequency questionnaires (for specific nutrients) 24-hour or 7-day recalls of number of foods or food groups (DD) 24-hour or 7-day recall of intake of pre-selected foods or food groups	Examples of food frequency questionnaires (Helen Keller for vitamin A intake (Helen Keller International 1994)) Examples of food group questionnaires: KPC2000 and DHS+ (www.measuredhs. com)	*From data collected at child level:* ➤ % 6-23 mo. children who consumed animal foods ➤ % 6-23 mo. children who consumed dairy products ➤ % 6-23 mo. children who consumed vitamin A-rich fruits or vegetables ➤ % 6-23 mo. children who consumed fortified foods (list locally available ones) ➤ Mean number of foods or food groups consumed ➤ % 6-23 mo. children with low, average, high dietary diversity (based on sample- and age-specific tertiles)

(continued)

Feeding Practice	Recommendation/ Guiding Principle[a]	Child-level Information needed	Data collection approach	Comments, issues to consider	Examples of questions[b]	Population-level indicator
						⋗ % 6-23 mo. children who received supplements: iron, vitamin A, or iodized oil *Note: A reference period needs to be selected for these indicators (24-h, 7-d or other)*
SAFE PREPARATION AND STORAGE OF COMPLEMENTARY FOODS						
Hand washing	⋗ Wash caregivers' and children's hands before food preparation and eating	⋗ Caregiver reports washing hands before cooking, feeding child (y/n) ⋗ Caregiver reports washing child's hands before eating (y/n)	Recall (24-hour or usual practice) or observation	Recall methods are subject to systematic overreporting of good practices. Observations may be less prone to biases, but are time-consuming, expensive, often unfeasible, and subject to reactivity.	*For recall methods:* 1. When do you usually wash your hands? (open-ended question with pre-coded answers) 2. When do you usually wash the child's hands? (same as above) feeding him/her? 3. Do you usually wash your hands with soap? 4. Do you usually wash the child's hands with soap?	*For recall methods; data collected at child level:* ⋗ % caregivers who report washing own hands before cooking ⋗ % caregivers who report washing own hands before feeding child ⋗ % caregivers who report washing child's hands before feeding ⋗ % caregivers who usually wash own hands with soap ⋗ % caregivers who usually wash child's hands with soap
Safe food preparation and storage	⋗ Cooked food should be served within 30 minutes of preparation and stored at > 60°C or < 5°C. ⋗ Stored foods should be re-warmed at > 60°C before eating.	⋗ Child is fed freshly cooked food (y/n). ⋗ Child fed food re-heated appropriately (if previously stored). ⋗ Child fed food stored in refrigeration or stored for < 30 min. at room temperature, and covered.	Recall (24-hour or usual practice) or observation	Same concern about overreporting of good practices, and reactivity of observations. Impossible to measure temperature of food or storage place.	1. Do you cook in advance for the child and store leftovers (specify foods fed to child)? 2. How often do you cook these foods for the child (every meal, 1/day, every 3 days, etc.)? 3. Where (and how) do you store leftover food (child food); do you cover them?	*For recall methods; data collected at child level:* ⋗ % caregivers who report cooking food for child and storing at room temperature for > 30 min. ⋗ % caregivers who report re-warming previously cooked food prepared for child before serving it ⋗ % caregivers who report having no refrigeration (no frig or local cold storage facility)

(continued)

Feeding Practice	Recommendation/ Guiding Principle[a]	Child-level Information needed	Data collection approach	Comments, issues to consider	Examples of questions[b]	Population-level indicator
					4. Do you re-warm stored food thoroughly (may need to ask how long it takes to re-heat) before serving it to the child? 5. Do you have a frig. or another type of locally adapted cold storage facility?	
Clean utensils and avoidance of baby bottles	➤ Use clean utensils to prepare/serve food ➤ Use clean cups/bowls to feed child ➤ Avoid feeding bottles	➤ Mom reports washing and drying cooking and feeding utensils before using. ➤ Feeding bottles are used (y/n).	Recall (24-hour or usual practice) or observation For bottles: recall: 24-hours (as per WHO 1991)	Same concern about overreporting of good practices and reactivity of observations Bottles may not be used every day. May be better to use longer recall period. Useful for interviewer to check around for signs of baby bottles	1. What utensils do you usually use to give liquids to child? Ask to see. 2. Did you feed child with a bottle in past 24 hours 3. What utensils do you usually use to feed child CF. Ask to see. 4. How often do you wash bowls and other utensils to feed child; alternatively: when did you wash them yesterday?	*For recall methods; data collected at child level:* ➤ % of caregivers who report washing and drying feeding utensils/bowls before feeding child ➤ % of children < 12 mo. bottle-fed in past 24 hours (WHO 1991) or ➤ % children who have been bottle-fed in past 7 days, mo., or since birth
Water used in food preparation	Water used to prepare cold drinks or uncooked food for child should be boiled or treated.	➤ Caregiver reports treating the water used for preparing food and drinks for child (y/n) (in areas where water is unsafe).	Recall (yesterday) or usual practice	Again possible bias toward over-reporting of good practice	1. Where do you get the water you use for preparing food or drinks for child? 2. Do you usually treat the water you use to prepare drinks or food for child? 3. If yes, how do you treat it (probe alternatives)	*For recall methods; data collected at child level:* ➤ % caregivers who treat water used to prepare food and drinks for child (boil, chlorine, etc.) *Note: indicator should be used only in areas where water is unsafe.*

Feeding Practice	Recommendation/ Guiding Principle[a]	Child-level Information needed	Data collection approach	Comments, issues to consider	Examples of questions[b]	Population-level indicator
CARE DURING FEEDING						
Feed directly or assist in eating	Feed infants directly and assist older children, being sensitive to hunger and satiety cues	➢ Caregiver reports feeding the infant 6-12 mo. or helping the older child 13-23 mo. (y/n). ➢ Caregiver reports that she provides food when the child acts hungry or requests food. ➢ Caregiver is able to recognize hunger cues. ➢ Caregiver is able to recognize satiety cues. ➢ Caregivers utilize strategies to determine if the child is full.	Usual practice or recall (yesterday)	Again possible bias towards over-reporting of good practice	1. Is your child able to feed him/herself? 2. If not, how do you help your child to eat? 3. How do you know that your child is hungry? 4. How do you know if your child is full? 5. Are there ways to check to make sure that your child is full? 6. What do you do if your child stops eating to make sure that they are full?	➢ % of caregivers who report feeding infants 6-12 months of age directly ➢ % of caregivers who report assisting children 13-23 months of age in eating ➢ % of caregivers who report feeding their child when their child asks for food ➢ % of caregivers who report at least one cue that their child is hungry ➢ % of caregivers who report at least one cue that their child is full ➢ % of caregivers who report at least one positive strategy to test whether their child is full
Feed slowly and patiently	Feed slowly and patiently and encourage your child to eat.	➢ Caregiver knows one positive strategy for teaching her child to eat. ➢ Caregiver knows one positive strategy for encouraging child to eat. ➢ Caregiver reports making her child finish the plate.	Usual practice or recall (yesterday)	Again possible bias towards over-reporting of good practice	1. How does a child learn to eat? 2. How does a child learn to use utensils? 3. Did you teach your child how to eat? 4. If so, in what ways? 5. Do you encourage your child to eat? 6. If so, in what ways?	➢ % caregivers who report at least one positive strategy to teach child to eat ➢ % caregivers who report at least one positive strategy to encourage their child to eat ➢ % caregivers who don't make their child finish their plate ➢ % caregivers who offer "one more bite"

(continued)

Feeding Practice	Recommendation/ Guiding Principle[a]	Child-level Information needed	Data collection approach	Comments, issues to consider	Examples of questions[b]	Population-level indicator
		➤ Caregiver reports offering the child "one more bite."			7. Do you make your child eat everything, even if they appear full before finishing? 8. If your child seems full, do you offer them "one more bite"?	
Handling food refusal	Utilize various strategies if a child refuses food.	➤ Caregiver knows one positive strategy for overcoming food refusal.	Usual practice or recall (yesterday)	Again possible bias towards over-reporting of good practice	1. Does your child ever refuse to eat, or stop eating before finishing everything on their plate? 2. If so, what do you do in response?	➤ % caregivers who report at least one positive strategy for overcoming food refusal
Protective environment for feeding	Feed child in a protected environment.	➤ Caregiver identifies a consistent adult as caregiver for feeding. ➤ Caregiver reports a backup plan when the primary caregiver is not available. ➤ Caregiver reports whether there are animals present in the place where the child eats. ➤ Caregiver reports whether child is fed from a separate bowl.	Usual practice or recall (yesterday)	Again possible bias towards over-reporting of good practice	1. Who generally feeds your child? 2. How old is this person? 3. What if that person is not available? 4. Where does the child usually eat? 5. Are there animals near by? 6. Does your child have his/her own bowl to eat from? 7. Do you sit down with your child when he/she is eating?	➤ % children fed by a consistent adult caregiver ➤ % caregivers who report a backup plan for that caregiver ➤ % caregivers who don't allow animals in the area where the child eats ➤ % children fed with separate bowl ➤ % caregivers who report sitting down with their child during eating

(continued)

Feeding Practice	Recommendation/ Guiding Principle[a]	Child-level Information needed	Data collection approach	Comments, issues to consider	Examples of questions[b]	Population-level indicator
		➤ Caregiver reports whether she sits down with the child when the child eats.				
Feeding times for learning and love	Feeding times are moments of learning and love.	➤ Caregiver reports whether she talks to child as child eats. ➤ Caregiver reports whether she names food or teaches the child about food/eating. ➤ Caregiver reports whether she allows child to learn to feed self. ➤ Caregiver reports whether she provides food to be eaten with fingers.	Usual practice or recall (yesterday)	Again possible bias towards over-reporting of good practice	1. Do you talk to your child while he/she is eating? 2. Do you teach your child about the foods they eat? 3. If so, in what ways? 4. Do you let your child feed him/herself? 5. Do you give him/her food to eat with their fingers?	➤ % caregivers who report talking to their children at mealtimes ➤ % caregivers who report allowing their children to try to feed themselves ➤ % caregivers who provide finger foods to their children

[a] The recommendations stated here are based on the draft document titled: "Guiding Principles for Breastfeeding and Complementary Feeding" (PAHO/WHO 2003).

[b] Questions listed in this column are merely "examples" of possible questions. They are by no means intended for universal use; rather, their formulation needs to be adapted to each specific context.

[c] We have chosen to use 24 hours as the recall period. As discussed in Section 3 (Assessment of Current Versus Past Behaviors, page 12), however, the recall period selected should be based on the objective of the research.

Breastfeeding

Information on breastfeeding is necessary to determine whether the child is still receiving breast milk after six months of age and to estimate the quantity ingested. This in turn is necessary to assess the amount of energy and nutrients that should be contributed by complementary foods. Direct measurement of breast milk intake is complex, even in exclusively breastfed children. Approaches such as isotopic techniques, test-weighing, and analysis of nutrient composition of breast milk can be used in small samples but are impractical for large-scale use. Thus, simpler methods based on maternal recall have been widely used to determine whether mothers currently breastfeed their children. The usual recall period is 24 hours, because in order to maintain breast milk, mothers have to breastfeed regularly. Thus, if they have not breastfed the child in the previous 24 hours, it is unlikely that the child is receiving a meaningful amount of nutrients from breast milk.

Information on the intensity of breastfeeding can also be collected by recall, by asking mothers the number of times they breastfed their child during the previous day and night. In one study, the frequency of breastfeeding was highly correlated ($r = 0.63$) with the volume of breast milk consumed (Brown et al. 1982). It may be useful to examine this relation in other settings to determine whether sufficient homogeneity exists to allow for an accurate and precise prediction of breast milk intake from the recall of breastfeeding frequency that could be applied broadly. If not, context- or population-specific equations to predict breast milk intake from breastfeeding frequency will have to be developed.

Assessing breastfeeding frequency by recall is sometimes difficult because mothers are often unable to remember the number of times they breastfed their child during the previous day and night. Many mothers report breastfeeding as often as the child wants, implying that they breastfeed "on demand." Although highly desirable and reflecting responsive feeding and caregiving, "on-demand" breastfeeding is difficult to quantify. This is particularly problematic, because the number of times children of the same age request to be breastfed may vary widely; therefore "on demand" does not

provide sufficient information about breastfeeding frequency. Thus, even developing a cultural definition of "on-demand feeding," or estimating the distribution of feeding frequency by the child's age among women who report feeding on demand is unlikely to provide the information needed regarding breast milk volume or energy intake. Therefore, it is recommended that when women characterize their breastfeeding frequency as being "on demand", a second-level question be introduced to assess how frequently the particular infant/child asks for the breast.

In summary, indicators to assess breastfeeding during the period of complementary feeding should focus on whether breastfeeding is continued through at least 23 months, and whether more than a minimal or token amount of breast milk is offered to the child to confirm that there is some nutritional value in the continued breastfeeding. Information on breastfeeding frequency should also be gathered in order to get at least a rough estimate of breast milk intake, for example, to be able to assess whether breast milk intake is likely to be low, average or high.

Breastfeeding indicators can be defined to include the entire age range (6–23 months) or specific age groups of interest, depending on the usual age of termination of breastfeeding. For example, if breastfeeding declines markedly around 12 months of age in a given population, it may be appropriate to use an indicator that includes children between say, 9 and 15 months. An important aspect that also needs to be considered in selecting appropriate age ranges for this indicator is sample size. In surveys that include all children under the ages of two or three years, it is possible that the number of children within three- or six-month intervals is relatively small (say, under 100), which may lead to imprecise estimates (i.e., large confidence intervals around the estimate). This, in turn, reduces the ability of the indicator to detect differences or changes over time (especially if they are small), and therefore reduces the usefulness of the indicator for monitoring and evaluation or for comparison purposes. It is thus important to take into consideration sample size issues when selecting age groups for specific indicators.

Box 1: Potential Indicators to Assess Breastfeeding Among Children Ages 6-23 Months

1) Percent of children breastfed yesterday among 6–23 month old children; (and/or other age groups such as 6–8 month, 9–11, 12–14; 15–17; 18–20; 21–23 month if sample sizes allow; or 6–11, 12–17, 18–23; or other, as appropriate)

2) Percent of children breastfed yesterday at least the minimum number of times for age (minimum number of times to be determined)

3) Percent of children breastfed "on demand," according to local definition (note that this indicator should be used as a proxy for responsive feeding, rather than to estimate breast milk intake)

Energy Intake, Energy Density, Frequency of Feeding, and Amount of Energy Served/Consumed per Meal

Energy intake from complementary foods can be measured directly, either by observation of food preparation and consumption, or by quantitative food records or recall history. Energy intake from these foods is then calculated as the product of the amount of each food consumed multiplied by the energy content of that food. Food energy content can be estimated from food composition tables or analyzed by bomb calorimetry. The actual methods for collecting dietary intake data are described in standard textbooks of nutritional assessment (Gibson 1990) and are not reiterated here. The major disadvantage of collecting quantitative dietary intake data to assess energy intake is the fact that dietary methods are tedious and labor intensive. Direct observation or weighing is more accurate and precise than recall history, but it requires the presence of an observer for long periods of time (including overnight to capture nocturnal breast milk intake), which is costly and could possibly induce changes in normal feeding behaviors (reactivity). Recall histories require less time for data collection than observational studies, but the data collector needs to be skilled to elicit accurate recall information. Food records require a literate, highly motivated population. As discussed, day-to-day variability is high, and thus a one- to three-day snapshot of dietary intake (whether through recalls or records) can still be subject to significant amounts of random

error. However, when estimating dietary intakes at the population level, specific techniques can be used to infer the distribution of true usual intakes. Such calibration techniques are widely used in national nutrition surveys such as the NHANES in the United States. A literature on the best means of collecting the required information for calibration is developing rapidly (Willett 1998b; Willett 1998a; Institute of Medicine 2000).

If food intake is not measured directly, energy intake from complementary foods can be estimated by using proxy measures for the three interrelated factors that contribute to energy intake: (1) the average energy density of complementary foods, (2) the frequency of feeding, and (3) the amount of food consumed during each feeding episode. As already described, these three factors need to be taken into consideration simultaneously, and "optimal" behaviors can only be defined locally depending on the relationships among these three factors. Because the amount of food consumed is likely to be measured imprecisely in most large survey or program contexts, the following sections propose methodologies to assess energy density and feeding frequency; however, they do not focus on estimating quantities.

It is important to recognize that in the absence of information on one of the three aspects that determine energy intake (in this case amount consumed), the information derived from the other two indicators will be useful only at the population level. For example, an individual child cannot be classified as having appropriate energy intake based on the fact that he/she is being fed a diet of appropriate energy density the recommended number of times. Without information on the amount consumed, the adequacy of the child's energy intake remains unknown. At the population level, however, it is still useful to assess the percentage of children who are fed less frequently than the minimum recommended times and to determine whether the energy density of complementary foods is generally above the minimum 0.8 kcal/g.

Group Recipe Trials to Assess Average Energy Density of Main Sources of Energy

This section describes a method to assess the average energy density of the main sources of energy in children's diet at different ages. It is based on the assumption that infants and young children receive the bulk of their energy from one or two foods—usually a cereal- or tuber-based porridge. It is therefore particularly important to assess the distribution of energy density of these main foods when detailed quantitative dietary intake data is not available.

The method consists of gathering information on recipes and preparation methods used to prepare complementary foods for infants and young children. This can be done in a variety of communities or regions, which then allows the derivation of a community-level average energy density.

Group recipe trials—or participatory cooking sessions conducted with small groups of caregivers—have been used successfully in a number of contexts to gather information on the main complementary foods and to develop improved recipes based on locally available ingredients (Dickin, Griffiths, and Piwoz 1997; Piwoz 1994; Kanashiro et al. 1991; Bentley et al. 1991a). A recent experience in Haiti showed that the trials were useful to gather information about the types of complementary foods usually prepared and served to infants and young children at different ages, and to inform about specific preparation methods and ingredients used. All ingredients and the final amounts of the food prepared could also be weighed during the trials so that the energy and nutrient composition could be quantified (Menon et al. 2002).

As indicated earlier, the method is based on the assumption that infants derive most of their energy from one or a few complementary foods. This is likely to be true for infants up to 12 to 15 months of age—but not much beyond—as in most cultures children start consuming the family diet early in their second year of life. Although this is a potential limitation of the approach, the 6–12 month period is clearly the age interval of most concern regarding energy density. Once children have transitioned to the family

diet, dietary diversity, nutrient density and amounts consumed, rather than energy density per se, become the greatest nutritional concerns.

Box 2: Potential Indicators of Group- or Community-Level Energy Density of Main Complementary Foods

1) Average energy density of main complementary foods fed to children 6–8 months of age

2) Average energy density of main complementary foods fed to children 9–11 months of age

Note: indicator is based on data collected at the group- or community-level

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The group recipe trial approach needs to be validated to determine the variability in recipes and in energy density of the main sources of energy within and across population groups. Research is also needed to assess the validity of the key assumptions underlying the approach, i.e., that (1) only one of two complementary foods provides the bulk of the energy among infants, and (2) that this is true for 6 to 12-month-old infants across cultures.

The main rationale for estimating average energy density of complementary foods is to determine whether the recommended feeding frequencies of 2 to 3 meals/day for 6 to 8-month-old children, and 3 to 4 meals/day for 9 to 23-month-old children apply to the population of interest. As indicated in the Guiding Principles (PAHO/WHO 2003), these recommended feeding frequencies apply to diets with energy densities of at least 0.8 kcal/g. Thus, if estimates reveal that the energy density of the main complementary foods is lower than this level, strategies to improve infant and young child feeding practices should focus on increasing energy density rather than achieving the recommended age-specific feeding frequencies.

Measurement or Estimation of Feeding Frequency, Including Snacks

Measuring feeding episodes and distinguishing between meals and snacks are challenging. It is first necessary to define what is meant by a feeding episode. In fact, this definition may be somewhat arbitrary, particularly with regard to young children, who may eat small amounts of food, fall asleep or get distracted, and then resume eating—the same or other foods—a short while later. It is not certain whether this example should be considered a single feeding episode or more than one. Because of this uncertainty, some investigators arbitrarily define a feeding episode as any food consumption separated by previous food consumption by a fixed amount of time, such as 10 minutes or a half hour.

Distinguishing between meals and snacks is equally challenging, and the definitions may vary across settings. It is not known whether there is any nutritional significance in making this distinction, except that given gastric capacity and energy density concerns, young children need to be fed more frequently than the typical family meal pattern in many cultures; and if snacks are provided (extra opportunities to eat), it is more likely that a child's energy intake will be met. Perhaps more important to consider is that querying the caregiver regarding both meals and snacks may lead to a more precise estimate of dietary intakes.

Any of the quantitative methods of measuring dietary intake (whether by direct observation, food records, or recall history) can be used to collect information on feeding frequency, so long as either the times when feeding episodes start and end are recorded or a specific rule set is established to identify separate feeding episode. However, since feeding frequency is to be used as an alternative indicator when detailed quantitative information is not available, a simpler approach to measuring feeding frequency is required. The approach can be as simple as asking the caregiver to recall the number of meals and snacks provided to the child during the previous 24 hours, or it may involve a set or questions and probes to help caregivers recall the feeding events of the previous day. If a simple question is asked, prior qualitative work and pretesting of the question is

required to derive local definitions of meals and snacks and to ensure that the question is understood properly.

Box 3: Potential Indicators to Assess Frequency of Feeding Complementary Foods Among Children Ages 6–23 Months

1) Percentage of children ages 6–8 months fed complementary foods at least two times/day
2) Percentage of children ages 9–11 months fed complementary foods at least three times/day
3) Percentage of children ages 12–23 months fed complementary foods at least three times/day
4) Percentage of children ages 6–23 months fed at least one snack in previous 24 hours

Note: These indicators should be used only if average energy density of the diet is ≥ 0.8 kcal/g.

Nutrient Density—Dietary Quality

Nutrient density refers to the amount of nutrients present in foods or mixed diets in relation to their energy content. The approach taken in recent work (Dewey and Brown 2003; Brown, Dewey, and Allen 1998) to estimate whether age-specific nutrient requirements could be met from breast milk and complementary foods was to examine the nutrient density of the usual diet of the child. In this approach, one calculates the amount of each micronutrient per unit of energy intake (e.g., mg/100 kcal) in the usual diet, and uses this information in combination with the energy requirements of the target population to consider whether micronutrient needs will be met with the usual dietary pattern and/or with optimal energy intakes (if energy is limiting in the diet). This approach is appropriate to derive this type of information, but again, it is likely to be of limited use for the purpose of large-scale assessments because it requires detailed quantitative information on the usual dietary intakes of infants and young children. Moreover, for some nutrients like vitamin A, additional information would be required to address issues of seasonality of intake.

Another approach that has been used extensively, and particularly so for the assessment of vitamin A intake, is the use of food frequency questionnaires. This method is based on the careful selection of a number of different foods, based on their ability to accurately predict the adequacy of intake of a particular nutrient at the population level (Sanjur 1982; Helen Keller International 1994). The list of pre-selected foods is usually drawn from validation studies in which quantitative dietary recalls or records are used to identify the main sources of a particular micronutrient in the usual diet of the population studied. This type of food frequency questionnaire has been adapted to a variety of contexts for the assessment of vitamin A intake, but it has not been applied internationally to examine the adequacy of usual nutrient intakes in young children.

Finally, an even more simplified version of this approach is to use a food or food-group dietary diversity questionnaire. Although only a few validation studies have been carried out to date in developing countries, the results are consistent in showing a strong association between food group dietary diversity and nutrient adequacy for a number of nutrients (Hatløy, Torheim, and Oshaug 1998; Ogle, Hung, and Tuyet 2001; Onyango, Koski, and Tucker 1998). In Guatemala, greater food diversity among infants aged 9–11 months was associated with higher intake of energy, protein, fat, and all the vitamins and minerals examined, although it was not associated with greater nutrient density (as percentage of energy) (Brown et al. 2002). By contrast, infants who obtained a larger percentage of their energy from animal source foods (ASF) had a significantly greater intake of energy and nutrients, as well as a greater nutrient density for a number of nutrients. Thus, in this population, increased dietary diversity was associated with greater intake of energy and nutrients, but it did not enhance the nutritional quality of the diet, whereas higher intake of ASF was associated with both greater nutrient intake and dietary quality.

The well-documented contribution of ASF to nutrient adequacy is now reflected in the new Dietary Guidelines, which recommend that infants be fed meat, poultry, fish, or eggs daily, or as often as possible (PAHO/WHO 2003). Recent research also suggests that not only should ASF be consumed regularly to ensure adequate daily intake of

certain key nutrients such as iron and zinc, but they also need to be consumed in relatively large amounts (Darmon, Ferguson, and Briend 2002; Brown et al. 2002). More research is needed to determine the minimal amounts of different types of ASF required at different ages to prevent nutrient deficiencies. Dairy products also contribute significant amounts of certain nutrients, such as calcium, and there is a suggestion they have a growth enhancing effect, even among breastfed children (Grillenberger et al. 2002; Ruel 2003).

Vitamin A-rich fruits and vegetables are also recommended daily because of the recognized importance of preventing vitamin A deficiency. These foods also contribute other essential nutrients.

Finally, other potentially important sources of micronutrients include fortified processed complementary foods or other available fortified foods, as well as supplements.

Thus, in defining proxy indicators for nutrient adequacy, it is important to include both indicators of overall dietary diversity and indicators of intake of specific foods or food groups known to contribute significant amounts of specific nutrients in a given population. These include locally available ASF, dairy products, vitamin A-rich fruits and vegetables, and fortified processed complementary foods. Intake of iodized salt or of other vitamin A-, iron-, or multiple micronutrient-fortified products should also be assessed. This will require prior identification of these products through qualitative work and an assessment of the availability of the products in local markets. Intake of micronutrient supplements, especially vitamin A and iron should also be assessed.

A list of potential diversity-type indicators that can be used to assess nutrient adequacy is provided in the box below. For the overall dietary diversity indicator, either the number of foods or food groups consumed over a given reference period can be used. Note, however, that in the absence of universal standards for "optimal" number of foods or food groups, sample-specific cutoff points are needed to create meaningful categories of dietary diversity (e.g., low, average, high). Sample- and age-specific terciles have been

used successfully for this purpose in a number of studies (Ogle, Hung, and Tuyet 2001; Brown et al. 2002); Arimond and Ruel 2003).

Box 4: Potential Indicators to Assess Nutrient Adequacy of Complementary Foods and Supplements Among Children Ages 6–23 Months

1) Percentage of children ages 6–23 months who consumed animal products

2) Percentage of children ages 6–23 months who consumed dairy products

3) Percentage of children ages 6–23 months who consumed vitamin A-rich fruits or vegetables

4) Percentage of children ages 6–23 months who consumed fortified products (indicators should be developed for each type of fortified product, e.g., iodized salt, vitamin-A fortified sugar, iron-fortified flour, micronutrient-fortified processed CF, etc.

5) Mean number of foods (or food groups) consumed by children

6) Percentage of children ages 6–23 months with low, average, or high dietary diversity for this sample (sample- and age-specific terciles of dietary diversity can be derived from data on the mean number of foods [or food groups] consumed [indicator 5]).

7) Percentage of children ages 6–23 months who received iron supplements (in past month, for example—specify type); vitamin-A supplementation (in past six months); iodized oil; or other micronutrient supplements

Note 1: All these indicators can be derived from either a 24-hour recall or another preselected reference period; all can also be computed for children aged 6–23 months or for specific age groups of interest.

Note 2: Specific, locally available foods consumed in sufficient (to be defined) amounts need to be identified with prior qualitative work; available fortified products also need to be identified prior to developing indicator 4.

Note that the indicators proposed below are purposely defined in general terms. They will need to be adapted locally to include specific examples of available foods. Specific foods such as liver, eggs, or mangoes, for example, may be singled out if they are available and likely to contribute significantly to young children's nutrient intakes. Foods, however, should be selected based not only on their nutrient density, but on their frequency of use *and* on the amounts usually consumed. Foods like fish flour, for

example, are commonly used in the preparation of gruels for infants and young children in some African countries, but they are often used in minute amounts—as condiments— and are unlikely to contribute significant amounts of nutrients to children's diets. It is therefore necessary to identify these foods through prior qualitative inquiry and to set exclusion criteria for foods consumed in token amounts.

Appropriate Consistency of Main Complementary Foods for Age of the Child

The precise consistency of complementary foods is difficult to assess in survey contexts. However, some simple assessment can be made of whether the usual porridges or other main sources of energy in the child's diet tend to be very thick or very liquid. For most purposes here, it will likely be sufficient to assess the general consistency of complementary foods at the group or population level (for children of different ages), and this could be done through the group recipe trials and/or other qualitative research methods. Another issue relates to whether or not the texture of the foods offered is appropriate for young infants with poorly developed chewing skills.

Safe Preparation and Storage of Complementary Foods

Experience with the measurement of hygiene practices abounds. As indicated in Section 3, recall methods to assess hygiene practices are generally not recommended because they tend to overestimate the prevalence of good practices. Observational methods are considered the method of choice for measuring hygiene practices, but they are not practical for measuring specific activities such as food preparation and feeding, because the observer needs to be present exactly at the time when these activities take place. Structured observations are also time- and resource-intensive, so simpler and faster methods are required for wider use. The spot check observation method described earlier is likely to be useful to assess general hygiene of the house or compound and to characterize the cleanliness of specific individuals (e.g., child caregiver). This method, however, is not appropriate to assess hygiene during food preparation and feeding,

because this would require direct observation of meal preparation and consumption, which is impractical. Further, such methods do not deal with the inherent within-subject variability in these behaviors; this point, however, does not negate their usefulness for population-level inferences.

With these limitations in mind, we have identified a series of potential indicators based on caregiver recall that can be used to assess the hygiene practices related to food preparation and child feeding included in the Guiding Principles (PAHO/WHO 2003). These include indicators for the following aspects: (1) hand washing; (2) safe food storage; (3) clean utensils to prepare and serve foods; (4) clean cups and bowls for feeding children; and (5) avoidance of feeding bottles. We also include an indicator for safe water use.

For the use of baby bottles, the existing WHO indicator (WHO 1991) can be applied. This indicator is based on the proportion of infants under 12 months of age who are receiving any food or drink from a bottle in the previous 24 hours. Indicators based on longer recall periods (e.g., seven days, previous month, or even since birth) could also be tested, because it is possible that even though bottle feeding does not occur every day, it can still increase the risk of infections in young infants.

Note that the recommendations concerning the ideal temperature for storage and re-warming of food before consumption cannot be measured by recall. Thus, the measurement of this aspect of the recommendations can only be done through imperfect proxies that estimate whether the food is reheated and/or consumed warm.

The importance of carefully designed survey instruments cannot be overemphasized for the collection of information on hygiene practices, which are highly subject to overreporting of good practices. Methods should be developed that will prevent providing clear leads to respondents of the expected answer. For example, asking a caregiver whether she washes her child's plate before feeding him/her is likely to elicit a positive response. However, the question can be asked in a more general, and less leading way, such as asking when the caregiver washed her child's plate yesterday, or how many times the caregiver wash it during the past 24 hours? A follow-up question at some other

point during the interview may be asked to verify at what time the child was fed the previous day. Information from the different questions can then be linked during data analysis.

Examples of potential indicators to assess hygiene during food preparation and storage are provided in the box below.

Box 5: Potential Indicators to Assess Hygiene During Preparation and Storage of Complementary Foods

1) Handwashing:

    a. Percentage of mothers who report washing their hands before cooking
    b. Percentage of mothers who report washing their hands before feeding the child
    c. Percentage of mothers who report washing child's hands before feeding him/her
    d. Percentage of mothers who usually wash their hands with soap
    e. Percentage of mothers who usually wash child's hands with soap

2) Safe storage and re-warming of cooked food:

    a. Percentage of mothers who report preparing food for the child and storing leftovers at room temperature for more than two hours
    b. Percentage of mothers who report re-warming the food for the child thoroughly before serving previously cooked food (among those who report storing food)
    c. Percentage mothers who report having no refrigeration or other locally adapted form of cold storage facilities

3) Clean utensils to prepare and serve food and to feed child:

    a. Percentage of children fed with clean utensils (Percentage of mothers who report cleaning and drying utensils and vessels used to feed the child before using)

4) Avoidance of feeding bottles:

    a. Percentage of children under 12 months fed with baby bottles in previous 24 hours

5) Water used in food preparation:

    a. Percentage of mothers who report treating the water (e.g., boiling, adding chlorine) used in nonboiled liquids and foods given to the child (where water is unsafe to drink)

Care During Feeding

Although feeding behaviors or styles are recognized as key determinants of dietary intake and nutritional status of young children, there has been little research on

the development of indicators to capture various aspects of feeding behaviors. International research on feeding behaviors has relied on qualitative methods or on structured observations of caregiver-child interactions during feeding in natural (home) settings. As is true for observational methods to quantify dietary intake or to characterize hygiene behaviors, observations of feeding behaviors or style would be labor intensive and probably not amenable to use for large population assessment, monitoring and program evaluation. Alternatively, one could query caregivers about usual feeding behaviors or about parenting theories that underlie feeding behaviors. For example, Birch has developed a Child Feeding Questionnaire (Birch et al. 2001) to assess the extent to which caregivers accept or reject parenting theories that support a controlled style of feeding, and this tool has been applied in studies in the U.S. to examine risk of obesity in young children (Spruijt-Metz et al. 2002). Similar tools to characterize laissez-faire or responsive feeding are not currently available.

From the standpoint of simplicity, the development of valid and reliable questionnaires to assess feeding style—or parenting theories that lead to them—would be optimal for monitoring and evaluation. This is a key gap in indicator development, and resources should be devoted to determine the contribution of optimal feeding behaviors to dietary intakes, growth and development in children, and to develop appropriate indicators for monitoring and evaluation of such behaviors in the programmatic context. Presented below are two proposed formulations for indicator development in this area. In the first, indicators to characterize feeding behaviors or styles are presented, and in the second, indicators to characterize psychosocial care as it relates to feeding are presented. As noted, these lists are not mutually exclusive.

Box 6: Potential Indicators to Assess Feeding Behaviors or Style

1) Frequency (or prevalence) of responsive feeding behaviors:

   a. % of mothers who report encouraging their child to eat
   b. % of mothers report sitting down with their child at meals
   c. % of mothers who report feeding or assisting their child to eat
   d. % of mothers who report talking to their child about food and eating during meals
   e. % of mothers who report that when and how much to eat is a decision made by the parent and by the child
   f. % of mothers who report that their child eats from a separate bowl
   g. % of mothers who respond with other than "crying" when asked: "How does you child tell you that he/she wants food or is hungry?"
   h. % of mothers who report at least one positive strategy for getting a child to eat
   i. % of mothers who report at least one positive strategy for checking to make sure that the child has had enough to eat
   j. % of mothers who provide food when the child asks for food

2) Frequency (or prevalence) of controlling feeding behaviors:

   a. % of mother who report that they decide when, where and how much their child eats
   b. % of mothers who report pressuring or forcing their child to eat
   c. % of mothers who report making their child finish all their portion regardless of appetite
   d. % of mothers who report that food is sometimes withheld as a punishment or given as a reward for good behavior

3) Frequency (or prevalence) of laissez-faire feeding behaviors:

   a. % of mothers who report that their child feeds themselves or eats without any assistance (do for 6-11 and 12-23 children separately)
   b. % of mothers who report that children know when and how much to eat
   c. % of mothers who report that responding to a child's food preferences will "spoil" a child

Note 1: all of these indicators refer to usual practice or core beliefs about feeding a young child. Alternatively, some of them could be formulated to ask about behaviors over a specific time period such as the previous day.

Note 2: Some indicators can be formulated in the converse and be considered in another category. For example," % of mothers who report that their child eats from a separate bowl" under responsive feeding could be considered as part of laissez-faire feeding as "% of mothers who report that their child does not eat from a separate bowl".

Box 7: Potential Indicators for Psychosocial Care During Feeding

1) Feed infants directly and assist older children, being sensitive to hunger and satiety cues:

   a. % of mothers who report feeding infants 6-11 months of age directly
   b. % of mothers who report assisting children 12-23 months of age in eating
   c. % of mothers who report feeding their child when their child asks for food
   d. % of mothers who report at least one cue that their child is hungry
   e. % of mothers who report at least one cue that their child is full
   f. % of mothers who report at least one positive strategy to test whether their child is full

2) Feed slowly and patiently, encouraging the child to eat:

   a. % of mothers who report at least one positive strategy to teach their child to eat
   b. % of mothers who report at least one positive strategy to encourage their child to eat
   c. % of mothers who report making their child finish their plate
   d. % of mothers who report "offering one more bite" when their child appears full

3) Utilize various strategies if a child refuses food:

   a. % of mothers who report at least one positive strategy in response to a child refusing food

4) Feed in a protective environment:

   a. % of mothers who report that their child is usually fed by a consistent 'adult' caregiver
   b. % of mothers who can respond as to what happens when the principle caregiver is away
   c. % of mothers who report that animals are present in the area where the child eats
   d. % of mothers who report that child eats from a separate bowl
   e. % of mothers report sitting down with their child at meals

5) Feeding times are period of learning and love:

   a. % of mothers who report talking to their child about food and eating during meals
   b. % of mothers who report allowing their children to try to feed themselves
   c. % of mothers who report giving their children "finger foods"

Note 1: all of these indicators refer to usual practice or core beliefs about feeding a young child. Alternatively, some of them could be formulated to ask about behaviors over a specific time period such as the previous day.

Note 2: Some indicators can be formulated in the converse and be considered in another category. For example, "% of mothers who report that their child eats from a separate bowl" under responsive feeding could be considered as part of laissez-faire feeding as "% of mothers who report that their child does not eat from a separate bowl."

6. Research and Indicator Validation Priorities

This section summarizes the recommendations of this report regarding the indicators for the measurement of different aspects of complementary feeding practices and highlights research priorities to validate these indicators.

Continued Breastfeeding

➢ *Current breastfeeding status*: Simple recall methods to collect data on current breastfeeding status have been widely used and seem to provide reliable and precise estimates. It is recommended to use a 24-hour reference period to ensure that the mother breastfeeds regularly, and thus is more likely to have an adequate supply of breast milk.

➢ *Breastfeeding frequency*: Information on breastfeeding frequency is usually collected by recall by asking mothers the number of times she has put the child to the breast in the previous 24 hours. Validation studies to assess the usefulness of recall information on breastfeeding frequency should be designed according to the purpose for which the indicator is to be used.

  o If the purpose is to determine whether breast milk provides a minimum amount of nutrients to children at different ages, the association between breastfeeding frequency and total breast milk intake and composition should be tested using appropriate methods to collect data on breast milk intake and nutrient composition.

  o If the purpose is to determine whether breastfeeding is on demand, or responds to the child's needs, observational studies should be carried out to determine what "on demand" means in a particular context and to assess the average number of times children of different ages who are breastfed on demand are actually put to the breast over a 24-hour period.

    Research and validation studies are needed to determine whether or not the information on breastfeeding frequency that is currently being collected in

many studies around the world (in all nationally-representative DHS surveys, for example) is useful at least to accurately differentiate between children who have low vs. high breast milk intake. Validation studies should also be undertaken to assess the accuracy of recall methods compared to observational approaches.

Energy Intake From Complementary Foods

➢ The optimal approach to measuring energy and nutrients from complementary foods is quantitative dietary assessment. When individual intakes are to be estimated, the number of days of recall should be selected based on information on usual day-to-day variability for each nutrient of interest. For population assessments, however, the 24-hour recall approach is usually appropriate, and specific techniques have been developed to correct for the distribution of true usual intakes at the population level (Willett 1998b;Willett 1998a; Institute of Medicine 2000).

➢ When quantitative dietary intake data at the individual level is not available, information on energy density of the main sources of energy, combined with amount usually consumed and frequency of feeding can be used to estimate, indirectly, the adequacy of energy intake from these complementary foods at the population level. This report addressed measurement approaches and indicators only for two of these factors (energy density and frequency of feeding) because measuring amounts through the use of simple tools appeared likely to provide inaccurate assessments, and thus to be of little use.

➢ *Energy density:* In Section 5, we recommend a simple approach using group recipe trials to assess average energy density of main complementary foods at the population level. The method needs to be validated by assessing the variability in recipes and in energy density of the main sources of energy within and across population groups. This will help determine the sample sizes required to obtain

precise estimates of average energy density of complementary foods in different contexts.

The method also needs to be validated in different contexts and for different age groups. It is possible that our main assumption—that infants receive most of their energy from a few key complementary foods—holds mainly for infants in their first year, and that it is not valid in most contexts for children in their second year of life. In many cultures, children start consuming the family diet as early as 12–15 months of age. It may be much more difficult to assess average energy density of the diet in such cases. However, as indicated before, the key nutritional concern of children who consume the family diet is likely to be the low micronutrient density and insufficient amounts consumed rather than energy density.

As noted in Section 5, the method proposed to assess average energy density of the diet is also likely to result in significant levels of misclassification of individual children, and thus the sources and magnitude of the misclassification should be assessed to determine whether the levels of error are acceptable, even for population estimates. Specifically, misclassification from individual variations in breast milk energy intake, from differences in recipes and preparation methods for main complementary foods, which in turn affect average energy density of the diet, and variations in quantities consumed by individual children should be assessed.

➢ *Feeding frequency:* Recall methods to assess feeding frequency should be validated against observations. In addition, recall methods based on a simple question should be compared with a more step-by-step approach that asks a series of questions to help caregivers recall feeding episodes during the previous day. The nutritional contribution of snacks in the diets of infants and young children at different ages also needs to be better understood. In some cultures they may be important sources of energy, while in others they may contribute mainly to micronutrient intakes. Research should be undertaken to test the validity of

various recall-based methods in assessing meal frequency and in differentiating between meals and snacks, compared to observational methods.

Nutrient Density of Complementary Foods

➢ The simplest tool identified to assess micronutrient intake is the measurement of dietary diversity, defined as the number of foods or food groups consumed over a reference period. Considerably more research is needed, however, to assess the usefulness of dietary diversity indicators to predict intake of a variety of essential nutrients.

➢ A number of methodological aspects also need to be addressed in developing and validating dietary diversity indicators. These include the classification systems for foods and food groups, the reference period for the recall, the scoring system and the cutoff points to define low and high diversity, and the inclusion/exclusion criteria (based on amounts) for different foods (Ruel 2002). More research is needed to determine whether all dietary diversity indicators and their cutoff points have to be defined locally, or whether a more "universal" approach to the selection of food groups (as used in the DHS) would be suitable at least for some purposes. The advantage of using standard food groups is the possibility of making comparisons between studies carried out in different populations, countries, or regions. The same is true for cutoff points. It is unclear at this time, however, whether it will be possible with additional validation studies to identify food groups (and possibly cutoff points) that can be universally meaningful to characterize dietary diversity in populations with widely different dietary patterns. For instance, is there a number of food groups below which all children will be at higher risk of not meeting their nutrient requirements for most nutrients? Conversely, is there a number of food groups above which nutrient adequacy will be achieved for most children, in most environments? These key questions need

to be answered before dietary diversity indicators can be recommended for wider use as indicators of nutrient adequacy.

➢ The contribution to micronutrient intake of specific food groups such as eggs, liver, poultry, meat, or dairy products needs to be better understood. The question of whether certain high-quality foods or food groups could be used as *sentinel* food groups or as *proxies* for nutrient adequacy should also be addressed in future validation studies.

Safe Preparation and Storage of Complementary Foods

➢ The main concern with the measurement of food safety and hygiene practices is the validity and reliability of recall approaches, as discussed previously. Handwashing has been shown to be particularly poorly assessed by recall methods because respondents know that handwashing is desirable and thus tend to over-report it (Curtis et al. 1993; Stanton et al. 1987). The same is likely to be true for questions regarding hygiene during food preparation, and possibly also for water treatment, especially in populations that have been exposed to hygiene education.

➢ There is a need to specifically validate indicators of hygiene during preparation and storage of complementary foods based on recall against more rigorous approaches, such as structured observations for multiple days. It would also be useful to explore the possibility of developing spot-check observation methods for certain practices related to food hygiene and safety. For example, efforts could be made to develop a methodology to conduct spot observations of certain key hygiene practices during feeding episodes. Spot-check observations have been shown to require substantially less time than structured observations and to be less reactive, because observers are usually able to carry out the observation rapidly and discretely (Ruel and Arimond 2002). Spot-check instruments to measure hygiene during food preparation have not yet been developed to our knowledge.

Care During Feeding (Feeding Behaviors and Psychosocial Care)

➢ Indicators of feeding behavior: There is a tremendous amount of work to be done to develop and test indicators of feeding behaviors within the context of psychosocial care during feeding.

➢ We recommend relying on maternal or caregiver reporting instead of relying on structured observations of behavior during a specific meal or feeding event. Although one would ideally like to know about usual feeding behaviors (recognizing the variability inherent in feeding behavior), it is not known whether caregivers can report their usual behavior, or whether more accurate reporting of behavior would occur if caregivers were queried regarding their behaviors over a specific time period (e.g., day prior to interview).

➢ Research is required on the precise wording of questions regardless of time frame; clearly, it would be important to use cognitive interviewing or other qualitative research techniques to further our understanding of how caregivers would interpret and respond to particular questions in this area.

➢ Finally, and most importantly, it would be important to validate these indicators against some reference measure of maternal/caregiver feeding behaviors, with the reference behavior likely to be based on structured observations of feeding behaviors over a meal or a series of feeding events.

Concluding Remarks

This report highlights the need to carry out a wide range of validation studies to accelerate progress in developing simple and useful indicators of complementary feeding. It is important to note that a number of existing datasets could be used to address most of the indicator validation needs identified here. An effort should be made to identify existing datasets that contain detailed quantitative information on dietary intakes of infants and young children of different ages and to design a global research agenda to address key methodological issues and validation needs. Standard analytical approaches

could be defined to ensure that comparable approaches are used in validation studies carried out with datasets from a wide variety of populations with different sociocultural characteristics and dietary patterns. Research to develop and validate simple tools to assess the crucial psychosocial care aspects of complementary feeding is also urgently needed.

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