

THE RELATIONSHIP OF CHILD GROWTH TO NUTRIENTS, FOODS, FOOD GROUPS
AND FEEDING BEHAVIORS DURING THE COMPLEMENTARY FEEDING PERIOD:
UNDERSTANDING CULTURAL AND BIOLOGIC REALITIES
IN A PERI-URBAN PHILIPPINE COMMUNITY

A Dissertation

Presented to the Faculty of the Graduate School

of Cornell University

in Partial Fulfilment of the Requirements for the Degree of

Doctor of Philosophy

by

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August 2013

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This study was motivated by a desire for a deeper understanding of why Filipino infants are undernourished so early in their lives, and what might be done to prevent this. Data from an urban poor Philippine community was used to conduct an analysis of complementary feeding (CF) practices and behaviors from two different perspectives: the biological and the socio-cultural. The underlying structure was provided by a global situation where scientifically-based guidelines for CF had been framed, and a set of indicators, to track progress in adherence to these guidelines and achievement of policy and program goals based on them, were in the process of validation. The over-all objective was to determine how the main CF indicators – Diet Diversity (DD) and Meal Frequency (MF) – would perform in assessing the status of infants 6 – 11 months old , and how this kind of assessment might ultimately be of use.

Ethnographic techniques were used to investigate the conceptual agreement between nutritional/public health professionals and mothers of the study infants. Definitional issues about foods and liquids, mothers' perceptions of breastmilk as a unique part of the infant's diet, and local concepts about meals and snacks and breastmilk were identified that have the potential to generate inaccurate communication as well as introduce a problem for DD and MF construction. This study demonstrates why local adaptation is essential.

DD is related to growth, but not the individual food groups; adding MF weakens this predictive association. The rationale for DD's use as an indicator of diet quality is its relationship with mean micronutrient adequacy(MMDA). MMDA was found inadequate even at the highest DD score. Intake of fortified products led to an attenuation of the relationship between MMDA and DD. The contributions of each food group to MMDA with each unit increase in DD is the same for breastfed (BF) and nonbreastfed (NBF) infants if breastmilk is counted as a food group. Not accounting for breastmilk's contributions to DD, as is the current practice, is conceptually counter-intuitive and potentially confusing requiring separate cut-offs for the BF and NBF.

BIOGRAPHICAL SKETCH

The author was born and raised in the City of Manila, Philippines, the eldest of six children of Enrique M. Santos and Paulina D. Caluag. She remembers growing up wanting to be a teacher, but her parents dissuaded her from taking up a course in education since she could teach anything she studied. She next wanted to take up law, but it was martial law in the Philippines at the time she finished high school and, knowing how outspoken she could be, her parents were afraid she would wind up in jail (at best) or dead (at worst) if she became a lawyer. And so her maternal grandfather, who was an obstetrician, intervened, reasoning out that if she was willing to study that long, she may as well be a doctor. She chose Family Medicine because she wanted to be able to handle any problem a patient could have. It was during residency training that she realized she was happiest working in communities on prevention programs. Her first job was with the Infant Feeding Intervention Study (IFIS), working on the development and implementation of a breastfeeding and complementary feeding project. The IFIS led her to her mentors – Medy Saniel, Bert Pelto, Gretel Pelto and Jean Pierre Habicht. It was Gretel who urged her to take up a Masters in Anthropology and subsequently this PhD in Nutrition at Cornell. It is data from IFIS that Gretel, JP and this author worked on in this dissertation.

The author's life and story would be incomplete without her husband, Jose M. Acuin, whom she met during her Asian History class as a freshman in college. Lito and their five children – Lara, Joel, Benjie, Mico and Sintia – have been her anchor and refuge throughout. She waited a long time to start and to finish this PhD in the midst of all the happenings in her family and in her career. But then she has always believed that all good things are worth waiting for.

ACKNOWLEDGEMENTS

I would like to acknowledge the assistance and contributions of the following, without whom this dissertation would not have materialized:

-the RITM Infant Feeding Intervention Study team, headed by Dr. Mediadora Saniel, especially to Noni Cerillo, Beth Vargas, Portia Alday, Angie Balis, and our supervisors and field staff

-the mothers, infants and health workers of our Muntinlupa study sites

-the WHO/UNICEF/IFPRI/UC Davis CF Indicators Working Group, under the leadership of Drs. Bernadette Daelmans, Katherine Dewey, and Marie Ruel, with the hands-on guidance provided by Mary Arimond and her team, and colleagues from the different country teams

-my colleagues at the University of the Philippines-National Institutes of Health, in particular at the Institute of Clinical Epidemiology, Dr. Mario Festin, Ms. Cynthia Cordero, Dr. Jojo Mantaring and Dr. Noel Juban

-my friends and colleagues from the Cornell Filipino Association, especially the Arquizas and the Savellas, and the Cornell Division of Nutritional Sciences Graduate Students Organization

-the Cornell Division of Nutritional Sciences faculty and staff, especially to Drs. Jere Haas and Katherine Rasmussen, Dr. Ed Frongillo, Ms. Francoise Vermeulen, and Ms. Gail Canterbury

-my committee members: Drs. Gretel Pelto (chair), Jean Pierre Habicht, David Pelletier, Rebecca Stoltzfus, and Cliff Scherer

-my extended family: my Mom and Dad, my siblings and their spouses, my aunts, uncles and cousins, especially those based in the US; my mother-in-law, aunts-, uncles- and-cousins-in-law; and to our household staff, Leo, Mimi and Monic

-and last but definitely not the least, my immediate family: Lito, Lara, Joel, Benjie, Mico and Sinta

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Chapter 1

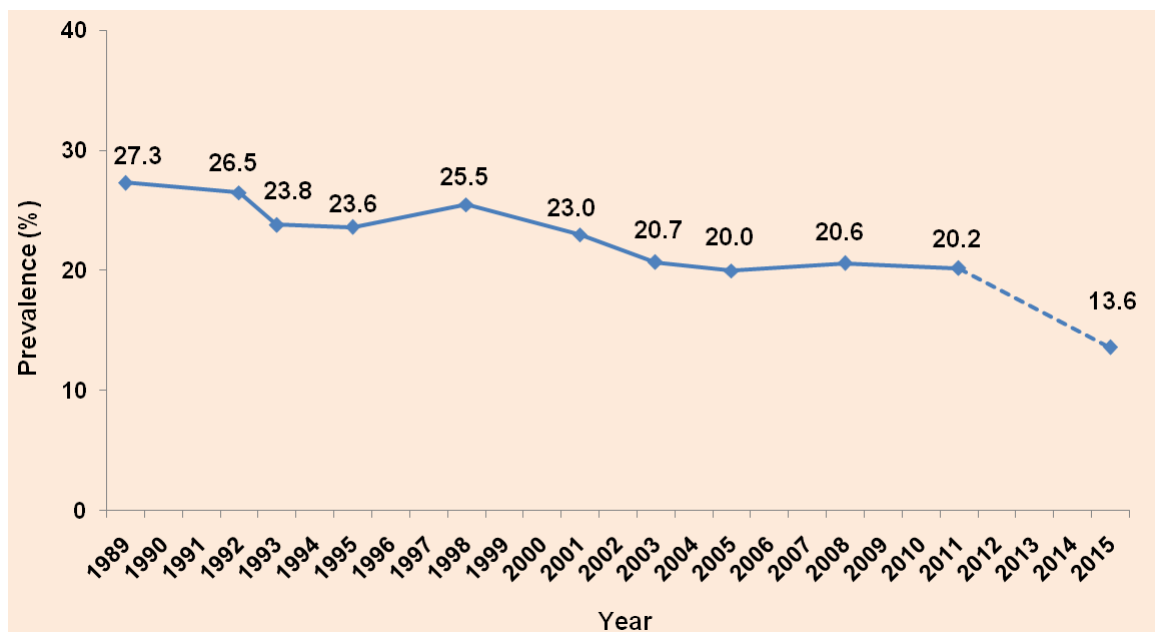
Introduction and Literature Review

Introduction

Childhood undernutrition remains an unresolved problem in developing countries. Allen (2012¹) in her review of global dietary patterns in childhood attributes this to the poor diets of both mothers and children. Mothers' nutrition is crucial to the developing fetus and to the breastfeeding infant, while breastmilk intake as well as the quality and quantity of complementary feeding (CF) are key determinants of the infant and young child's growth and health status.

This study was motivated by a desire for a deeper understanding of why Filipino infants are undernourished so early in their lives, and what might be done to prevent this. The over-all objective was to determine how the main CF indicators – Diet Diversity (DD) and Meal Frequency (MF) – would perform in assessing the status of infants 6 – 11 months old, and how this kind of assessment might ultimately be of use.

The current underweight prevalence of children under 5 years of age in the Philippines is about 20.2%, a proportion that reflects a very slow reduction from its 27.3% level in 1990 (Figure 1). National targets of a 1.2% rate of reduction annually have not been met, with prevalence practically unchanged since 2003 (FNRI, 2011²). Among the indicators being tracked as part of the Millennium Development Goals, halving the prevalence of undernutrition in children 0-5 years has been downgraded from a high to medium possibility of being achieved (Philippine MDG 2010³).



Source: FNRI National Nutrition Surveys, using WHO-CGS reference
 N.B. Broken line shows trajectory to MDG 2015 goal

Figure 1. Underweight prevalence among under-5 year old Filipino infants, 1989-2011

There is evidence (Victora et al, 2010⁴, Shrimpton et al, 2001⁵) to show that children in developing countries, even when born with adequate birth weight, begin to falter in both weight and length expectations as early as three months of age, with an acceleration in faltering during the transition period from exclusive breastfeeding to subsistence on family foods. This transition period, which earlier was referred to as the “weaning period” and is now referred to as the period of “complementary feeding,” begins when the child is around 6 months and continues until he/she is about two years of age. The foods introduced during this period are intended to complement milk intake at the outset, hence the term complementary feeding (CF). Children whose growth falters at this time become more vulnerable to illness and tend to remain undernourished. The combined effects

of poor nutrition and illness during this stage have been shown to contribute to poor social and mental performance in later life (Walker et al, 2001⁶). Intervention studies, such as the INCAP study (Martorell, 1995⁷), have demonstrated the potential for catch-up and compensation of deficits when delivered during this window of time. The complementary feeding period is thus crucial to reducing undernutrition in young children.

As the child transitions from milk alone (ideally breastmilk) to the diet consumed by the family, complex physiological, psychological and cultural factors come into play that affect his/her nutrient intake and consequently his/her nutrition status. Current explanatory models of the transition focus on and are driven by biological mechanisms and outcomes. Much research has gone into these biological processes and outcomes; hence we have a clearer understanding of how these operate (Gibson and Hotz, 2001⁸).

Public health interventions require behavior changes in order to positively affect less than adequate biological outcomes. These behavior changes operate within cultural contexts at individual, household and community levels. Efforts to assess the adequacy and efficacy of approaches to changing complementary feeding behaviors are hampered by many factors, including, in the recent past, the lack of appropriate indicators that will allow comparison between groups, as well as make it possible to draw inferences across different groups (IFPRI/UC Davis/WHO, 2005⁹). Thus we are unable to optimize lessons learned from pilot studies to broader populations and different contexts. Interventions are difficult to assess because there are few good measures of meaningful change in these behaviors. As a consequence, we find it difficult to identify who responds to interventions and who does not and are therefore unable to tell whether we are reaching those who need the help most.

The latter is important to the design of programs and policy in all setting but particularly in developing countries where resources to mount and sustain programs are limited.

The Infant and Young Child Feeding Indicators

A global initiative to improve complementary feeding behaviors has been launched by the world's health and nutrition organizations (WHO, UNICEF, and partners¹⁰). Two sets of guiding principles (for the breastfed child, PAHO/WHO, 2003¹¹ and for the nonbreastfed child, WHO 2005¹²) have been developed to assist in the development of feeding recommendations, and the indicators for measuring change as a result of the application of the principles released (WHO, 2008¹³).

A set of indicators for complementary feeding behaviors now known as the Infant and Young Child Feeding Indicators (IYCFI¹) underwent “a series of activities aimed towards definition and validation of indicators to reflect dietary quality and quantity, using existing data sets from 10 different sites in developing countries” (WHO, 2008). Research needs for validity, reliability, and responsiveness were balanced with the realities of what would be feasible (in terms of cost, capacity, etc) in low-resource settings where these indicators will be most useful. However, experience with indicators developed for breastfeeding tells us that there is a wide-range of purposes (such as promotion, advocacy, policy, monitoring) for which CF indicators might eventually be used (Piwoz et al, 2003¹⁴). A better understanding of how these proposed CF indicators might perform for these different purposes would help in identifying situations for which they may or may not work and what may be needed for them to work well when they do.

1 Hereinafter referred to as the IYCFI validation study

The materials that are presented in this thesis contributed to this larger effort (Working Group for IYCFI, 2006¹⁵) and focus on the use of three possible indicators to assess the quality of complementary feeding – diet diversity, frequency of feeding and sentinel foods. This work is motivated by the need to understand how these potential indicators are related to the more compelling reality of child growth. The first paper in this dissertation (Chapter 2) establishes the relationship between diet diversity and nutrient adequacy. The second paper (Chapter 3) investigates the associations between different measures of dietary intake, including diet diversity, meal frequency and sentinel foods, and child growth. The third paper (Chapter 4) relates issues around the use and interpretation of the WHO CF guidelines and indicators to the cultural and biologic realities of a peri-urban poor Philippine community.

The Infant Feeding Intervention Study (IFIS, Saniel et al ¹⁶) data set from the Philippines (described in the appendix) provides a unique opportunity for us to investigate these relationships between diet and growth at the very beginning of the CF period, when infants are just being introduced to foods and their growth is beginning to reflect the effects of this introduction

Review of the literature

This chapter contains a review of the literature that is pertinent for the three papers that follow. It provides a background for some of the biological, public health and nutrition issues related to these papers, which are intended to be “free-standing” and have their own references. Specifically, this review is organized as follows:

1. What is a useful indicator?

2. Diet Diversity Score (DD)
3. Mean micronutrient density adequacy (MMDA) as a gold standard
4. Sensitivity / specificity approach to compare indicators
5. Sentinel Foods : Animal source foods (ASF)
6. Frequency of Feeding (FF)
7. Assessing dietary requirements
8. Issues in applying indicators to dynamic changes within a narrow age group
9. Accounting for breastmilk contribution
10. Application to different contexts
11. Interpreting dietary measures– what is meaningful?

What is a useful indicator?

A good indicator provides information about an underlying reality that is more difficult or impossible to measure (Habicht & Stoltzfus, 1997¹⁷). For the indicators in this study – diet diversity, feeding frequency and sentinel foods – the underlying realities are diet quality, complementary feeding behavior, nutritional risk status, growth, and response to intervention. The underlying reality influences both the performance of the indicator and the decisions based on this indicator. This underlying reality is an inherent part of the context in which indicators are selected (Habicht and Pelletier, 1990¹⁸), which in turn is driven by the purpose for which the indicator will be used. Thus the answer to the question, “*Does the indicator measure what it is supposed to measure?*”, depends on the objectives of the activity for which the indicators will be used.

Ruel, Brown and Caulfield (2003¹⁹) gave a comprehensive list of criteria for evaluating the

performance of complementary feeding indicators that includes:

1. Key performance criteria: validity, reliability and responsiveness
2. Main threats to validity and reliability: bias, imprecision (random error), intra-individual variability, reactivity
3. Misclassification measures: sensitivity, specificity, positive and negative predictive values

These criteria do indeed help us assess whether an indicator is good or not, primarily from a research or scientific perspective. However, without an understanding of the purpose for which the indicator is intended it provides little guidance on whether one would want to use a specific indicator for a given situation or context.

The indicators for complementary feeding developed through the WHO/UNICEF initiative are intended for: 1) assessment: for comparison across groups and over time; 2) screening and targeting populations at risk to guide decisions about resource allocation; and 3) monitoring and evaluation of goals and impact of interventions (Dewey et al, 2004²⁰). Although it has been pointed out that no one indicator may be capable of meeting all these needs (Habicht and Pelletier, 1990; Habicht, 1980²¹) more recent work in this area (Ruel, 2003²²; Kant, 2004²³) illustrates experiences with the use of dietary diversity measures in association with varying outcomes, such as health and nutrition risks, growth and food security.

Fulfilling all the different intentions may be an ambitious expectation for an indicator, as pointed out by Habicht (1980), because “the research must also differentiate between the needs of nutritional assessment to estimate prevalence [as used in impact evaluations for example] and the needs of nutritional monitoring to estimate changes in prevalence [as used to determine allocation of

resources].... [There is an] unreasonable burden of expectations placed on these indicators...[The] usefulness of an indicator to select children with “abnormal” values of another indicator is not identical with selecting for some other definition of malnutrition [single micronutrient deficiencies for example, although probably not as crucial in developing countries where deficiencies are usually of multiple nutrients]”.

The need for a standard metric for complementary feeding (and in fact for measures of dietary intake) has long been felt. Dubois and colleagues (Dubois, et al. 2000²⁴) in their paper comparing different diet indicators developed in the US for possible application on their Quebec data set say this of standard measurement: “[There is a] need for comparability across different populations to determine the role of nutrition in social health inequalities”. Their hope is that a standard measure will help: 1) guide allocation of resources at the regional and global levels; 2) assess global recommendations; for assessing diets over time (as well as the effects of lag time between recommendation development and behavior change at population level); and 3) identify research needs common to groups of countries that may be sharing similar diet and nutrition problems. These same considerations also apply within countries where diverse populations, in terms of food choices and diet/nutrition problems, may be found. In addition to the indicator expectations above, a standard diet measurement could also be a way of assessing the impact of social transformations/ family structure change on feeding practices, of guiding the development of food products and of changing agriculture/ food policy on diet/food intake.

Recent work on the WHO/UNICEF CF indicators (Dibley and Senarath, eds. 2012²⁵, Disha et al, 2012²⁶, Ng, Dibley and Agho, 2011²⁷) have tended to emphasize the relationship of the indicators to

the usual socio-demographic determinants of infant and young child feeding, resulting in the expected conclusions that children from poor households, with younger, less experienced, less educated mothers are more likely to have poorer diets. There is a paucity of discussion on issues such as: what about diet diversity could be improved? What are the specific constraints to achieving a minimally acceptable diet? Given limited resources, how much emphasis should be placed on different intervention paths, for example, the marketing and distribution of fortified foods or increasing the frequency of feeding?

A more introspective look into what the indicators mean and how they are applied in a given context may lead to more pragmatic research on how different countries could interpret their CF patterns in ways that are useful for policy and practice.

Diet Diversity (DD) Score

Diet diversity measures are one of the most popular methods for capturing over-all diet quality, and one with which a substantial body of knowledge about both its methods and its applications has accumulated. It has received increasing attention as a measure of diet quality in the complementary feeding age group, as a consequence of the work done by Menon and Ruel (2002²⁸) using data from Demographic and Health Surveys in Latin America. They found that a child feeding index, which included diet diversity, strongly and significantly predicted child height for age z scores, even after adjusting for potential confounders such as child, maternal and household characteristics. Arimond and Ruel²⁹ supported these findings with 11 additional data sets from Latin America and Africa. Both sets of authors were motivated by the need for simple ways of assessing diet in this age group for program and research needs. Their experiences show that diet diversity is useful as an

analytic tool because it: 1) deals with the multicollinearity of different components of diet (Kant, 1996) and 2) is a relatively simple and easy to obtain dietary measure that retains aspects of diet complexity in a single measure, making it easier to interpret the relationships of diet to determinants and outcomes.

The diet diversity (DD) score has the potential to provide useful information about the over-all diet quality of complementary foods. The grouping of foods, when standardized, allows comparison of the diversity measure across groups and across time. This food grouping approach, unlike individual food scores, allows the DD score to capture “typical daily food intake” from single day recalls. However, the score will not provide information about specific foods, and this limits its application for nutrition education or health promotion.

The simplification into food groups does not allow assessment of finer attributes of quality within a food group, such as intake of whole grain vs. refined grain products or of liver vs. other flesh foods that can make a difference in micronutrient intake. An important consideration here is the intake of nutrient-dense foods such as fortified foods and infant formula whose inclusion within a food group may attenuate the relationship between the DD and diet quality when measured by nutrient adequacy.

The DD score (by design) overlooks quantity so that a food just barely meeting a 1 gram intake cut-off is counted equally as a food that may have been taken in large amounts. In addition, each food group is given equal weight within the score hence it will not provide information regarding the contributions of individual food groups to the diet. For example, a staple, which is usually consumed in relatively large quantities on a day-to-day basis, would contribute as much to the score as an

occasional food.

Kant in her review (1996) observes that the definition of diet quality depends on the investigator and the “prevailing dietary guidance”. For example, cancer researchers will group foods according to currently available evidence related to attributable cancer risk, such as antioxidant properties . These groupings will differ from those of investigators interested in cardiovascular disease who may group foods according to their fat and sugar content. The WHO complementary feeding indicator study grouped foods according to nutrients that are known to be deficient in infants and young children in developing countries (Dewey et al, 2004¹⁹).

Kant points out that few studies validate diet indices against “biochemical, anthropometric, and clinical parameters of nutritional status...[though] some have been examined in relation to health outcomes...”. Her review includes indices that have been developed through a data-driven method of grouping foods (using factor or cluster analysis). These indices are specific to a given data set and may be difficult to replicate and compare with others. She found no information on estimates of variability (inter- or intra-individual), which are important in understanding the utility of these indices. In our analysis, we validated DD against a nutrient adequacy measure (MMDA) and examined its relationship to anthropometric outcomes, but it was not possible to look into intra-individual variability.

Mean micronutrient density adequacy (MMDA) as a gold standard

This study calculated a mean micronutrient density adequacy (MMDA) measure from the individual nutrient density measures of 10 nutrients considered a “problem” in the 6 – 23 months age

group – Vit. A, thiamin, riboflavin, folate, Vit. C, calcium, iron and zinc (Dewey and Brown, 2003³⁰; WHO, 1998³¹). These nutrients were defined as having the “most discrepancy between their content in complementary foods and the amount required by the infant” based on studies in Peru, the USA and Mexico. These findings are supported by Gibson, Ferguson and Lehrfeld (1998³²) and by more recent work in the Philippines by Perlas, Gibson and Adair (2004³³) who also identified the same limiting nutrients from their analysis. The MMDA is the standard against which diet diversity was tested, following the protocol of the IYCFI validation study (Arimond et al, 2005³⁴).

Energy intake was measured and tested against frequency of feeding in the IYCFI validation study. Protein intake, however, is not addressed by any of the indicators proposed in the light of evidence that protein does not appear to be limiting in this age group (WHO, 1998). In the sub-sample of 30 infants for which this analysis was carried out in the Infant Feeding Intervention Study, protein intake from complementary foods was more than adequate at 6 and 12 months for nonbreastfed infants and was at 55% (6 mos) and 72% (12 mos) of RDA for breastfed infants². In contrast, energy intakes were at 75% (6 mos) and 68% (12 mos) for the nonbreastfed and only 27-28% for both periods for breastfed infants. This gives us reason to believe that energy may be more crucial to the diet than protein in this age group.

Chapter 2 presents the analysis of the ability of diet diversity to predict MMDA in a context where fortified products are being given to infants. This is unique to this study as the other country data sets did not have a sufficient sample of infants consuming fortified products for this analysis to be done.

2 The contributions of breastmilk to the diet were not measured in the RITM Infant Feeding Intervention Study

Sensitivity / specificity approach to compare indicators

The validation protocol developed for the IYCFI validation study made use of the sensitivity/specificity approach – where a selected level of the indicator that determines the least misclassification in terms of nutrient adequacy (and hence diet quality) is used as a cut-off. This approach considers the cost of missing kids who need intervention (high false negative) as well as the cost of treating/ intervening when not necessary (high sensitivity/low specificity). However, this procedure requires measurement of precision and undependability that will change the shape of the distribution of the indicator (Habicht, 1980). This may in turn influence the sensitivity/specificity curves to the extent of changing the cut-off points. For the IFIS study, data collection quality checks were put in place in recognition of the importance of these measurements, but data are not available to quantify either precision or undependability.

Other concerns about using this approach, particularly for screening purposes, were best expressed by Habicht (1980): “The best indicator and its best cut-off point for purposes of nutritional monitoring can in theory be exactly and universally determined. The best indicator to estimate the true prevalence of disease for nutritional assessment can also usually be determined universally...[but] in screening, different needs and local circumstances play a large role in determining the best indicator and its best cut-off point, although sensitivity and specificity data collected elsewhere may be useful for this local decision...”. The issue of prevalence is particularly relevant, not specifically for this thesis, but to the larger validation study which sought to establish a standard dietary measure with a common cut-off.

Although it is recognized that more than one indicator may be needed to assess complementary

feeding, it is helpful to compare different indicators, e.g., DD score with single sentinel/ index foods in their ability to identify children at risk. Habicht (2000³⁵, and with Frongillo, 2005³⁶) proposes the use of receiver-operating curves when selecting what he terms “a reflective indicator”, such as those that differentiate between better or worse nutritional status and those that predict health or survival outcomes based on nutritional variables. This definition of risk is primarily of interest in scientific or selected child development circles, but may need to be “translated” to be meaningful to other stakeholders such as mothers and frontline health workers.

For selecting response indicators (those that respond to nutritional influences) Habicht (2000) prefers to use the means or ordinary least squares regression analysis as these provide more statistically efficient comparisons. The better indicator/s would have higher standardized differences and require smaller sample sizes with this approach.

In earlier work, Habicht (1980) suggests that it would also be helpful to consider positive predictive values that are particularly useful in resource-poor settings because they are related to prevalence. In these settings, decisions are often made not on the basis of the performance of the indicator but on the capacity of the health system to provide limited quantities of intervention for those most in need. That said, many decision-makers would still like to have a scientific basis for their decision and will want to know the trade-offs (Habicht and Frongillo, 2005).

Sentinel Foods : Animal source foods (ASF)

Single foods are not usually considered good indicators of over-all diet quality, given that the usual consumption patterns contain multiple foods, and that food and nutrient interactions affect

absorption and metabolism (Kant 1996). However, a particular food group may act as a marker or a sentinel of diet quality, particularly during complementary feeding when diets are not as varied as those of adults. In this thesis, the individual food groups, animal source foods (ASF), and fortified foods were investigated for their potential as indicators of diet quality independent of their contribution/s to the DD score.

Animal source foods are known to be high-quality foods, contributing bioavailable micronutrients and essential protein components to the diet. Among the foods consumed by children of complementary feeding age, they have received much attention as part of interventions to improve child health and nutrition.

One of the first indications of the potentials of ASF as indicators come from the results of the Nutrition CRSP studies (Allen L, et al. 1992a³⁷ and Allen L et al, 1992b³⁸). Animal-origin foods proved to be good predictors of attained size at 30 months and of growth rates between 18 and 30 months, as well as modifiers of the effect of maternal weight on these outcomes and of the interaction between individual rates of weight and length growth.

A review presented by Gibson and Hotz (Gibson and Hotz, 2001³⁹) gives evidence of the efficacy and effectiveness of ASF in interventions. They discuss the usefulness of using the energy contributions of flesh- vs plant-based foods as a possible indicator of micronutrient deficiencies, particularly of zinc, given the current limits in assessing zinc levels in the body. The ASF indicator may therefore act as a proxy measure of micronutrients found in these foods that are not measurable because of technical or resource constraints.

A recent series of papers on an intervention trial conducted among Kenyan school children (Neumann C et al, 2003⁴⁰; Siekmann J, 2003⁴¹; Murphy S, 2003⁴²; Grillenberger M et al, 2006⁴³, Long J et al⁴⁴) provides further proof that ASF improves diet quality, Vit. B12 levels, lean body mass and growth.

Dewey et al (2004) tested each food group to determine which would be most predictive of nutrient adequacy using complementary feeding data sets from 4 developing countries (Peru, Honduras, Bangladesh, and Ghana). Not only was the ASF food group predictive of nutrient adequacy in all four countries, it outperformed DD score in Honduras, Ghana and Bangladesh, and performed as well as DD score in Peru. For this study, each of the individual food groups were tested as a potential sentinel group.

Frequency of Feeding (FF)

Frequency of feeding (FF) of complementary food has been used as a proxy measure for the amount of food eaten. It is an attempt to include a measure of quantity of intake that is fairly easy to obtain and can be reasonably standardized under most field settings. The study presented here tested the association between FF and energy intake from complementary foods and FF and growth.

In the 4-country analysis done at UC Davis (Dewey et al, 2004), FF was significantly correlated with both total energy and energy intake from complementary foods. The relationship is linear except in younger Peruvian infants (where it is curvilinear). Several measurement issues were raised by this analysis. The definition of feeding episodes varied across countries – in Honduras it was possible to

delineate meals and snacks and add them together to get feeding episodes. Such was not possible in Peru, where only information on feeding episodes was available. There were differences in identifying one feeding episode from the next --- the most common method was to designate a time interval, which would be feasible through observation in research settings, but may prove difficult to obtain from recall (which is what may be possible for programs). These issues are discussed in Chapter 4.

Assessing dietary requirements

Because this study was part of a multi-country project, the reference for nutrient and energy requirements was the same as those of the other sites. The Recommended Nutrient Intake (RNI) values from the Joint FAO/WHO Expert Consultation (2002⁴⁵) on Vitamin and Mineral Requirements in Human Nutrition were used. Micronutrient requirements for breastfed infants were based on the assumption of average breastmilk intake (IFPRI/UC Davis/WHO, 2005).

Issues in applying indicators to dynamic changes within a narrow age group

Most studies of food consumption have been done in adults whose diets and feeding behaviors are more varied than those of infants. The technical and behavioral research considerations in the complementary feeding age are quite different from adults. Although the age range is fairly narrow, children at this time are changing so rapidly in terms of their size, function and behavior that it is difficult to identify meaningful groups or categories. Most nutrition studies of complementary foods (and of nutrition requirements) use age categories as follows: 6-8, 9-11, and 12-23 months. However, researchers are aware that the 8 month old and 9 month old infants may be more similar to each other

(in terms of the relevant variables) than to the 6- or 11- month olds in their respective categories. This is even truer of the 12 month old (in relation to an 11 month old) and the 23 month old infants.

Feeding behaviors are likely to be more elastic at this stage as infants and caregivers try out new foods and feeding experiences and decide to continue some, stop others, and resume previously discarded ones perhaps even within one observation period. The possibility of misclassification is enormous given the range of experiences these infants are expected to encounter within the short interval and where multiple measurements are not likely to be available. This may make it close to impossible to expect an indicator that works well for population inferences to be equally useful at the individual level, unless tools are developed to make this translation.

Accounting for breastmilk contribution

What makes diet analysis in this age group particularly challenging is measuring the contribution of breast milk. Obtaining breast milk intake is time- and resource- intensive. It is also very intrusive. For almost all but research situations, it will not be possible to have a good measure of breastmilk's contribution to the infants' diets. And yet, continued breastfeeding is a key dietary recommendation in this age group and therefore needs to have an indicator.

The UC Davis team (Dewey et al, 2004) attempted various ways of accounting for breastmilk intake without measurements of the actual intake. Assuming adequate energy intake in the infants, the energy intake from complementary foods was considered as an inverse proxy for breastmilk intake. Infants were categorized to have low breastmilk intake if the amount of energy consumed from complementary foods was above the amount of energy needed from complementary foods when

breastmilk intake is assumed “average”. Inversely, infants would be categorized to have high breastmilk intake if the amount of energy consumed from complementary foods was below the amount of energy needed from complementary foods when breastmilk is “average”. Energy intakes from complementary foods when breastmilk intake is average were based on a review conducted by Dewey and Brown (2003). Similar values for low, average and high levels of breastmilk intakes in developing and industrialized countries are available from an earlier review compiled by the same authors for WHO (WHO, 1998). The values for breastmilk intake would then be considered as the complement to the energy intake from CF. The same logic would apply to the micronutrient contributions of breastmilk.

The number of infants who would be misclassified would obviously be larger for a dichotomous (low vs. high) grouping of breastmilk intake than would be the case for three categories (low, average, high). Moreover, the values (WHO, 1998) used as cut-offs for developing and industrialized countries differ. For example, in developing countries, the energy needed from CF for average breastmilk intake is 269 kcal for 6-8 month olds while it is 196 kcal for industrialized countries in this same age group. For the high breastmilk intake category, among 9-11 month olds, the energy intake needed from CF is 229 kcal in developing countries and only 121 kcal in industrialized countries.

Even if one were to look only at developing countries, it is known that there is considerable diversity in breastfeeding and complementary feeding patterns within these countries. There are urban and rural differences, as well as social and income group differences that may behave in a similar fashion to the differences between developing and industrialized countries with respect at

least to the energy contributions from CF.

Thus accounting for the contribution of breastmilk may be more difficult to standardize than other aspects of this indicator development process given 1) the uncertainties surrounding the assumption of adequate energy intake among the breastfed infants (see earlier discussion on energy intake, p.10), 2) the possible errors with the classification into low, average and high breastmilk intake categories, and 3) the unsettled differences in estimates of energy needed from CF in variable contexts.

For purposes of this exercise, where the focus is on the dietary contributions of complementary feeding, breastmilk intake was standardized as average. For the analysis on growth (Chapter 3), infants who shifted from one feeding category to another during the study period were excluded in order to minimize the “noise” coming from breastmilk. For the IFIS data set, the infants all came from urban-poor communities and they are all in the 6-11 month age range, but breastfeeding practices still varied considerably across age with profound effects on complementary feeding.

During the proposal development stage for this thesis, an approach considered to simplify these calculations was to think of breastmilk intake as a sentinel food, similar to animal source foods, particularly among the older infants. In retrospect, this approach may be the most sensible as breastfeeding status defined complementary feeding patterns (Chapter 2) and influenced the effects of these patterns on growth.

Application to different contexts

Most studies of diet assessment tools have been done in developed country settings. An example

is the Healthy Eating Index (HEI) developed by the USDA to monitor changes in intake over time and as a basis for health promotion (Kennedy et al, 1995⁴⁶). It attempts to assess diet quality in the context of the relationship between excess nutrient intake and chronic disease and how dietary guidelines may affect this relationship. The stated goal was “to construct an index of overall diet quality that incorporates nutrient needs and dietary guidelines for the US consumer into one measure” and “to monitor changes in consumption patterns as well as serve as useful tool for nutrition education and health promotion”. This approach to a diet assessment tool necessarily makes judgments (based on US dietary recommendations) about intakes that are then reflected in scores (contribution of fat to energy intake; saturated fat, cholesterol, sodium are of particular interest). There is only one (out of ten) component on variety of diet, reflecting a decision on how important diversity is to the over-all index.

These types of indices require complex data, selectively look at details, such as number of servings & portion sizes, and consider distribution of intake in the analysis. They also relate nutrient intake to guidelines adherence. They therefore meet a number of objectives of the different stakeholders involved in these kinds of assessments (researcher, policy-maker, consumer).

Developing countries have less variable diets, particularly among young children. Some feeding practices may deviate considerably from global recommendations (for example recommendations on exclusive breastfeeding during the first 6 months) while others may not (e.g., give a greater variety of foods as the child grows), so that the effects of an intervention using a composite index in the complementary feeding stage (analogous to the HEI) may be difficult to interpret.

Nevertheless, there have been numerous attempts to develop indices on complementary feeding. Ruel and Menon (2002) used an age-specific index that incorporated the following: current breastfeeding, use of complementary foods and liquids in the past 24 hours (this included diet diversity and food frequency), frequency of bottle use over the past week and feeding frequency. Using data from the Demographic Health Surveys of 7 Latin American countries, this index was found to be associated with child height for age z scores (HAZ) even after controlling for confounders. Sawadogo et al (2006⁴⁷) adapted the index (using a food variety score in addition to diet diversity) for a study in rural Burkina Faso and also found a significant association of their index with HAZ and weight for height z scores (WHZ) in the older age groups (12-35months) but not for 6 to 11 month old infants. On the other hand, Ntab et al (2005⁴⁸) in Senegal and Moursi (2008) in Madagascar, both, found no association of the index with HAZ or WHZ in their settings. In these subsequent studies, each research group modified the index to accommodate differences in data availability. An inherent limitation of indices is this arbitrary nature – some authors give additional points to selected practices such as breastfeeding, others would divide the distribution into groups and allocate points by groups of practices. This lack of a standard index makes it difficult to explain the differences found in these studies.

The incorporation of guidelines into an index presents an additional challenge in tracking change over time because diet recommendations evolve and can be adapted in different ways (making it even more difficult to standardize and remain relevant). There are normative and secular trends to consider – norms change over time; for example, the definition of what is a high quality diet has changed from one that prevents deficiency to one that reflects moderation and balance.

The current translation of the CF guidelines into the selected indicators – diet diversity, feeding frequency, and sentinel foods – might thus be considered just a part of what needs to be an evolving process. Other important tenets within the guidelines such as safe food handling and responsive feeding await further indicator development efforts.

Interpreting dietary measures– what is meaningful?

Meaningful change in an indicator can depend upon one's perspective. For a researcher, meaningful change in an indicator is often a technical issue – to what extent is the change seen actually due to the intervention (in a trial) or to the proposed mechanism (for an observation study). Do differences in the diversity score come about as a result of the intervention? Do these differences then reflect improvements in nutrient adequacy and do the improvements in nutrient adequacy reflect better growth/ health outcomes? Other research concerns may include the statistical treatment of the variable, and the range of nutritional status of the population (Habicht and Stoltzfus, 1997).

But there are other related considerations. Because most studies on dietary measures have been done on adults in developed countries, the main concern has been with chronic disease-diet relationships (Kant, 2004⁴⁹) and how diet indicators predict biological outcomes: mortality and illness (commonly cancer and cardiovascular disease). Such would not be the case in infants and young infants where the causes of morbidity and mortality are different and where an important outcome of interest is growth.

Ruel and colleagues (1996⁵⁰) illustrate the type of analysis discussed by Habicht (2000) using data from the INCAP supplementation trials in Guatemala. The objective of that study was to examine

whether determinants of risk (which are commonly used as screening indicators for interventions) are the same as determinants of differential benefit using the ordinary least squares regression analysis method. Thinness (low weight-for-age, weight-for-length, and mid-arm circumference) proved to be better predictors of differential benefit than the usual determinants of risk (maternal height, child stunting at onset, family characteristics, diarrhea, diet or socioeconomic factors). The cut-off points for identifying thin children who would respond was higher than the usual -2 SD of the median of NCHS standards, implying that applying the standard cut-off would have denied programs to a substantial number of children who could benefit from the intervention.

There are also more pragmatic issues related to understanding what indicators are telling us. In the context of programs, the current guidelines for complementary feeding provide the scientific basis for recommendations but they require translation into each, different, real world setting. For a policy maker, meaningful change may relate to equity issues in terms of food availability. Do the children who take in more fortified foods come from better off (or other equity-related characteristic) households regardless of the counseling (or other non-supplementation) intervention? In other words, is the food a marker of something other than nutrient intake? If so, how should we be interpreting the relationships that our analysis might be showing?

It is commonly recognized that the assessment of indicator performance in identifying children at risk needs to consider relevant factors that may confound or modify the relationship between the diet indicator and nutrition risk. Income and maternal education are just two of many possible factors (Ruel et al, 1999⁵¹). But not all such factors can be readily appreciated or measured.

For example, caregiving is a key determinant of child growth and health outcomes, and an important mediator between dietary intake and nutritional status. Pelto, Levitt and Thairu in their review (2003⁵²) examined 18 ethnographic studies to better understand the contexts within which caregiving influences child outcomes. They suggest that “among the components of caregiving for which direct links to nutrition can be traced are food selection and feeding practices, which affect ...nutrient density...” However, the WHO review (CAH, 1999) was not able to find studies that “permit one to distinguish the effects of behavioral changes in practices from changes in foods...” that could help explain the effects of caregiving and point out potentials for care-based nutrition interventions. It could be because measurement of caregiving behaviors had not yet evolved at the time of this review. A growing number of studies are emerging to both quantify and qualify caregiving, and provide an explanation for its effect on child growth and health, and test caregiving interventions (Ruel and Arimond, 2003⁵³; Arimond and Ruel, 2001⁵⁴; CAH, 1999⁵⁵).

Earlier work on the IFIS data set (Acuin, 1992⁵⁶) using a sub-sample of 100 mother- infant pairs demonstrated that clusters based on time allocation patterns of mothers’ activities predicted infant weight at 12 months with a similar (but insignificant) effect on height at 12 months. The clusters generated through a computer program were remarkably congruent to the mothers’ own grouping of activities related to child caregiving practices. The infants of mothers who spent the most time on childcare activities had the best growth outcomes at 12 months. With a better indicator of dietary intake, it may be possible to find out whether diet is an explanation for this effect.

In conclusion, at this stage in the development of indicators for complementary feeding, it would be highly informative to assess their performance for different purposes. A valid indicator that is

inappropriate for the specific purpose for which it is being used may lead to unsuitable conclusions, which could ultimately result in greater costs over time.

Chapter 2

The association between a diet diversity indicator and a nutrient adequacy measure is attenuated by fortified intake among peri-urban Filipino infants 6 to 11 months old

Abstract

We examine the relationship between a diet diversity (DD) score and micronutrient adequacy as part of a 10-country validation of indicators of diet quality during the complementary feeding period. We address the research question “How well can diet diversity indicators predict dietary quality for Filipino infants 6 to 11 months old from a periurban poor municipality?” Dietary intake, obtained from 24-hour recalls, was organized into food groups that were then aggregated into a DD score. Mean micronutrient density adequacy (MMDA) was used as the standard for diet quality against which the score was tested. MMDA increases as expected in the older BF (mean MMDA= 52.3) compared with the younger BF group (mean MMDA=47.8); however, for the older NBF, mean MMDA is lower (66.0) relative to their younger counterparts (mean MMDA=67.8). Considering that DD is higher among the older NBF, the relative decline in MMDA may be due to diet quantity factors that are not captured by looking at DD alone. MMDA and DD score are significantly correlated ($p < 0.01$, $r = 0.523$) with the correlation being stronger among the BF ($r = 0.643$) than the NBF ($r = 0.285$). However, the correlation coefficients for days with fortified product intake are lower than days without and no longer significant for the older BF ($r = 0.222$, $p > 0.05$) and the NBF ($r = 0.071$, $p > 0.05$) groups, indicating an attenuation of the relationship between MMDA and the diversity score. The interaction between fortified product intake and DD significantly ($p < 0.05$) affects MMDA. In contexts where intake of infant formula and fortified food products is common, wide nutrient

densities within the fortified food group reduce DD's utility to discriminate diet quality based on micronutrient adequacy. The addition of breastmilk as a food group would, conceptually, include its contributions to the DD, and reduce potential confusion in the score's interpretation operationally.

Introduction

Complementary feeding (CF) indicators advocated by the World Health Organization and UNICEF, with academic and development partners (WHO 2008⁵⁷ & 2010⁵⁸) have become the standard to track progress in the attainment of feeding recommendations. Given the diverse settings in which these indicators are being used it is important to take a closer look at the scientific rationale behind their development to better understand where and how they work. Of particular interest is a summary indicator for a “minimum acceptable diet” that has two main components: diet diversity (a proxy for quality) and frequency of feeding (a proxy for quantity).

The diet diversity (DD) measure is based on the number of food groups consumed by infants in this highly vulnerable age group. The concept of using a measure of diversity of food items in the diet as an indicator of dietary quality has a long history (Dewalt, Kelly and Pelto 1980⁵⁹; Bentley and Pelto 1991⁶⁰, Kant 1996⁶¹). More recently, its performance in adult diets has been extensively examined across a number of populations and shown to be effective in differentiating inadequate diets from more adequate ones (Kant 2004⁶², Hatloy 1998⁶³, Torheim 2004⁶⁴). Subsequent analysis of DHS data (Ruel and Menon⁶⁵, Arimond and Ruel⁶⁶) provide support that diet diversity could be useful for assessing infant and young child diets relative to nutritional status.

This paper investigates the performance of a DD indicator developed as a measure of nutrient

adequacy in a population of urban-poor Filipino infants.

Background

Between 2004-2006, WHO convened a Working Group on Infant and Young Child Feeding Indicators (WG-IYCFI) to carry out a validation project whose aim was to determine whether diet diversity could be used as a measure of diet quality of infants and young children. This required an examination of the proposed diet diversity measure's performance in relation to nutrient adequacy in ten different ecological, social environments (WG-IYCFI, 2006⁶⁷), among them a peri-urban Philippine population where a substantial portion of children are not breastfed after six months of age, and where infant formula and other fortified infant foods are used to some extent, even in poor households.

The objective of the WG-IYCFI was to “initiate a process of developing and validating indicators of diet “quality” and “quantity” during the first two years of life. The indicators are expected to help assess the extent to which guiding principles are being practiced. The validation protocol that was developed for the project (Arimond et al, 2005⁶⁸) focused on two of the CF Guiding Principles – the “nutrient content of foods”, and the “amount of food needed”. This paper relates to the first of two research questions of the WG-IYCFI research protocol: “How well can diet diversity indicators predict dietary quality for infants and young children in different populations with varying dietary patterns?” Diet quality is defined here as adequate micronutrient density of foods and liquids other than breast milk.

To distinguish between children who are “feeding well”, that is feeding in accordance with the

guiding principle on nutrient content of foods, and the children who are “not feeding well”, the WG-IYCFI protocol contains a measure for dietary quality based on micronutrient density (amount per 100 kcal) of foods and fluids taken by the child (excluding breast milk.) For breastfed infants 6 to 11 mo, the micronutrients included were (vitamin A, thiamin, riboflavin, vitamin B6, folate, vitamin C, calcium, iron and zinc); for nonbreastfed infants, vitamin B12 was added. These micronutrients are considered to be “problem nutrients”, defined as those that have the “most discrepancy between their content in complementary foods and the amount required by the infant” (Brown, Dewey, and Allen, 1998⁶⁹). Vitamin B12 is considered to be adequately provided in breast milk, assuming adequate maternal B12 status and adequate breast milk intake.

We present this analysis which follows the WG-IYCFI validation study protocol and aims (Arimond et al, 2005, that has been published in Moursi et al 2008) . In addition we would like to answer the following questions: 1) Is the association between DD and MMDA stronger than that of MMDA with any single or combined set of food groups (that could function as a sentinel food group/s), and 2) How would this relationship between DD and MMDA be affected by fortified intake?

Methods

Study site, data set and ethical concerns

The data used in this analysis are from the Research Institute for Tropical Medicine’s (RITM) Infant Feeding Intervention Study (Saniel 1993⁷⁰). They were collected from 1986-1988 as part of a baseline surveillance of the City of Muntinlupa, then a peri-urban town located about 25 km south of Manila.

Muntinlupa is an industrial and transportation hub along a major gateway from Metro Manila to southern Philippine provinces. On the east it is bordered by Laguna de Bay, the biggest natural freshwater lake on Luzon Island. Its location and economic development influence Muntinlupa's food supply sources, which range from commercial mass- and small-scale production to food stalls selling fish or other produce from the lake or home-made meals.

Except for the influx of fortified food products from the late 1990s, more recent food consumption surveys and national nutrition surveys (Pedro, 2006⁷¹; FNRI 7th NNS, 2008 & 2011) indicate that the feeding patterns and nutritional status of children in the early complementary period have remained largely the same since our data was collected

The author was a member of the original study team and obtained the consent of the principal investigator, and the administration of the institute. The original study protocol was reviewed by the RITM Ethics and Technical Review Board. The Cornell University Committee on Humans Subjects Research reviewed and classified this secondary analysis of the data as "exempt". The original data set has been stripped of all identifiers for this study.

Sampling and Survey Design

All infants born in the study area were screened and recruited if they met the following criteria: 1) dwelling unit criteria (made from make-shift or non-permanent materials), 2) birth weight at least 2.5 kg (as weighed by study team's field staff within 48 hours of birth), 3) gestation at least 37 wks (based on maternal recall of LMP), 4) singleton, 5) normal delivery, 6) absence of congenital

malformation that could affect feeding and 7) informed consent from parents.

Measurements of food intake, diet quality, diet diversity

A team of interviewers, who had been trained for the purpose, conducted monthly home visits to collect data. Supervisors carried out spot checks and random repeat interviews.

24-hour food recalls were obtained within 3 days of the monthly birthday from birth to one year. Infants who were ill at the time of a scheduled follow-up visit were re-visited for a repeat 24-hour food recall once they were well (within 1-2 weeks). Information on appetite was not collected. Food intake was included in this analysis only for well children in the 6 to 11 month age range.

Mothers were asked to recall the infant's dietary intake for the last 24 hours, and this included the following: frequency of breastfeeding and giving of milk and milk substitutes, kinds of liquids and solids given as well as frequencies and amounts, cooking process and ingredients, and use of an infant feeding bottle. Local household utensils and paper drawings were used to approximate sizes and amounts. Measurements of intake were obtained for cooked foods, if the food was consumed cooked, and in raw form if consumed raw.

Breastfeeding information was obtained from the 24-hour food recalls and from biweekly morbidity surveillance for diarrhea and other illnesses. Percent days breastfed was used to categorize children into breastfed (any breastfeeding), or non-breastfed (no breastfeeding). Within a given age group, breastfeeding status for 2 out of 3 months was used to classify a child into a breastfeeding category in the event of monthly variations in breastfeeding status. Breastmilk intake was not

measured.

The descriptive, correlation and regression analyses were carried out using SPSS v. 14⁷². Analytic procedures followed the design and methods in the WG-IYCFI protocol (Arimond et al, 2005; Moursi et al, 2008). The dietary diversity (DD) measure was calculated from the sum of the food groups with at least 1 g consumed over 24 hour period. The original 8 food groups were: 1) grains, roots, tubers, 2) legumes and nuts, 3) dairy, 4) flesh foods, 5) eggs, 6) Vit-A rich (130 RE/100g) fruits and vegetables, 7) other fruits and vegetables, 8) fats and oils. However, these were modified later (WHO, 2008) to exclude the fats and oils group, and the Vit-A rich group was replaced with an iron-rich group (see Discussion).

In addition, foods were flagged as fortified if they are specially developed for infants and young children. In this population, these foods included mostly infant cereals, such as those made by NestleTM and GerberTM, but did not include foods fortified for the general population (which were introduced into Philippine markets after the survey). Infant formula was also flagged as a fortified item.

Most of the values for energy, Vit. A, thiamin, riboflavin, pyridoxine, Vit. B12, Vit C, calcium, iron, folate (expressed as folic acid, found in meats, shellfish, fruits and vegetables), phytate and oxalate values are taken from the Philippine Food and Nutrition Research Institute's Food Composition Table FNRI FCT 1997⁷³. For infant formula and cereals and other processed foods, manufacturer's nutrient values were used when available from packaging, literature accompanying the product or literature from the manufacturer given to doctors. Otherwise, the Philippine FCT

values for the given food type (for example, a generic infant formula or generic infant cereal) were used.

Zinc and additional phytate, oxalate and B vitamin values (pyridoxine, folate, B12 in processed foods), which are not available from Philippine resources, were supplemented from the World Food Dietary Assessment (using the Indonesia data base) or the USDA Nutrient Database. In cases where a specific food's values could not be found (for example, for some local fishes or processed/bought-prepared foods), then values from a similar food (such as freshwater or saltwater and size, for example, in the case of fish; or similarly processed or bought-prepared foods with similar ingredients, as in the case of local varieties/preparations of rice cakes or breads) were used.

The standard against which diet diversity was tested was the mean micronutrient adequacy (MMDA). MMDA was calculated by taking the proportion of intake for each micronutrient relative to its requirement, and obtaining the average of each of these proportions for the 10 problem micronutrients (Brown, Dewey and Allen, 1998⁶) for non-breastfed infants in this age group and 9 nutrients for the breastfed (excluding Vit. B12). The micronutrients included are: Vit. A (RE, corrected for bioavailability), thiamin (mg), riboflavin (mg), Vit.B6 (mg), folate (ug) , Vit. B12 (ug), Vit. C (mg), calcium (mg, absorption adjusted based on oxalate content – 25% for legumes, roots/tubers and grains, 5% for foods with high oxalate, 45% for other fruits and vegetables, and 32% for all other foods, including dairy products), iron (mg, absorption adjusted based whether of plant (6%) or animal (11%) source, as specified in the validation protocol), zinc (mg, absorption adjusted based on phytate:zinc ratio – assumed to be 30% of p:z \leq 18%, and 22% of p:z >18%,). Micronutrient requirements for breastfed infants were calculated assuming average breastmilk intakes (Brown,

Dewey, Allen, 1998⁶), as breastmilk intake was not measured.

Results

Characteristics of the sample by age and breastfeeding status

From the original data set, 2654 child-days of observation were included in this analysis with 48% from breastfed infants.

Consumption by Food Groups

Children are almost invariably given rice – as gruel during the younger age group and as boiled rice when they are older. Almost 98% of breastfed infants' child-days and 96% of the non-breastfeds' had some grain/root/tuber consumption. For the non-breastfed, grains were a close second to dairy (98%); whereas dairy is a far second (37%) to grains for the breastfed group. The pattern of consumption for both feeding groups is similar thereafter – flesh foods (22% for breastfed and 24% for non-breastfed), other fruits and vegetables (~19% for both groups), eggs (15% and 16%), legumes and nuts (14% and 11%), fats and oils (about 5% for both groups)

Table 1. Percent of child days various food groups were consumed*, by age and breastfeeding status (1-gram minimum)

	n	Grains group	Dairy	Flesh foods	Eggs	Fruits & vegetables	Legumes & nuts	Fats & oils
<u>Breastfed</u>								
6-8 mo	703	97.01	36.27	16.79	13.51	20.34	12.80	5.41
9-11 mo	582	98.80	37.63	28.35	16.49	18.04	14.78	4.64
All (6-11mo)	1285	97.82	36.89	22.02	14.86	19.30	13.70	5.06
<u>Non-Breastfed</u>								
6-8 mo	665	93.68	97.44	19.10	14.89	19.55	10.23	4.81
9-11 mo	704	97.87	97.59	29.26	16.76	18.89	11.36	5.82
All (6-11mo)	1369	95.84	97.52	24.32	15.85	19.21	10.81	5.33

*No fruits or vegetables qualified as Vit A-rich using protocol definitions, hence all fruits and vegetables have been placed in one food group only.

The markedly higher dairy consumption among the non-breastfed comes from milk intake, usually either as infant formula or as powdered cow's milk. Fats and oils intake* is very low, despite the re-coding of food combinations and processed foods to capture consumption of this food group.

Diet Diversity Indicator (DD)

The mean number of food groups eaten per child-day was 2.1 for the breastfed infants, and 2.7 for the non-breastfed ones. Only the non-breastfed 9 to 11 month olds had a median intake of 3 groups per child-day eaten compared to 2 for all other subgroups.

The dominance of grains in infants' diets is readily apparent in Tables 2 and 3. Almost 90% of the time when only one food group is eaten, that food comes from the grains group, and is almost always rice³ in some form . When a second group is eaten, in three out of four child-days, the second group is dairy. Only when a third group is eaten does an animal source food aside from dairy, such as flesh foods or eggs, come into the picture. As the mean number of food groups eaten is 2, three or more food groups are consumed in only about 40% (for flesh foods; 25% for eggs) of child-days observed. Fats and oils, as well as other fruits and vegetables can also be this third food, in 30% of child-days.

3 Information re: rice intake comes from qualitative research. Rice is the staple in the Filipino diet.

Table 2. Percent of child-days on which different food groups were consumed, by food group diversity score for BREASTFED children aged 6-11 months (1-gram minimum)

	Number of food groups eaten (DD)						
	1	2	3	4	5	6	7
Percent (number) of child days at each diversity score	34.5 (443)	33.8 (434)	21.6 (277)	7.6 (98)	2.0 (26)	0.4 (5)	0
	Percent of child-days on which each food group was consumed						
<u>Food groups</u>							
Grains, roots and tubers	95.3	98.8	100.0	100.0	100.0	100.0	-
Dairy	3.4	43.3	66.1	62.2	84.6	100.0	-
Flesh foods	0.5	18.0	42.6	64.3	92.3	100.0	-
Eggs	0.5	14.3	25.3	40.8	46.2	100.0	-
Fruits and vegetables	0.7	15.2	34.7	64.3	69.2	60.0	-
Legumes and nuts	0.2	11.5	25.6	40.8	46.2	60.0	-
Fats and oil	0.2	13.4	39.7	70.4	92.3	80.0	-

Table 3. Percent of child-days on which different food groups were consumed, by food group diversity score for NON BREASTFED children aged 6-11 months (1-gram minimum)

	Number of food groups eaten (DD)						
	1	2	3	4	5	6	7
Percent (number) of child days at each diversity score	3.9 (53)	47.7 (653)	29.9 (409)	12.9 (176)	4.0 (55)	1.2 (17)	0.1 (2)
	Percent of child-days on which each food group was consumed						
<u>Food groups</u>							
Grains, roots & tubers	22.6	98.2	100.0	100.0	100.0	100.0	100.0
Dairy	75.5	98.3	98.8	99.4	100.0	100.0	100.0
Flesh foods	0.0	0.9	36.7	64.8	89.1	94.1	100.0
Eggs	1.9	1.1	24.4	40.3	50.9	47.1	100.0
Fruits and vegetables	0.0	1.2	26.4	51.1	76.4	76.5	100.0
Legumes and nuts	0.0	0.9	13.2	30.7	36.4	94.1	100.0
Fats and oil	0.0	1.1	24.4	54.0	83.6	94.1	100.0

Adequacy of nutrient intake

The nutrient contributions of the different food groups, shown in Tables 4 and 5, reflect as well the % of time or child-days when each of the food groups are consumed.

Grains are the source of most of the energy and folate for all infants. Dairy provides the highest contributions to vit. A, riboflavin, and calcium intakes. Other fruits and vegetables provide

the most thiamin for all, and vit. C for the breastfed. Eggs are the highest source of vit. B12 for the breastfed infants (Table 4) but not for the non-breastfed (Table 5), where vit. B12 comes mostly from dairy. Iron and zinc come mostly from grains in the breastfed and from dairy in the non-breastfed infants, but these two micronutrients are also sourced among dairy and eggs (for both feeding groups) with some amount coming from flesh foods (particularly for the breastfed). Because intake is so infrequent, flesh foods do not stand out as a major source of any nutrient.

Among breastfed infants (Table 4), grains, roots and tubers provide the most energy (54%), B6 (46%), folate (87%) iron (26%) and zinc (45%). Dairy supplies 72% of vit. A, 51% of riboflavin and 60% of calcium intakes. Vit. C appears to come from other fruits and vegetables (38%) and dairy (33%). Eggs provide the bulk of Vit.B12 (54%) and some iron (23%).

Among the non-breastfed (Table 5), dairy provides most of the nutrients (88% Vit. A, 74% riboflavin, 42% Vit. B6, 55% Vit. B12, 66% Vit.C, 79% calcium, 54% iron, 56% zinc). Folate comes mostly from grains (81%), while thiamin comes mostly from other fruits and vegetables (64%).

Table 4. Percent contribution of food groups to energy and nutrient intake from food, for breastfed children aged 6-11 mos (n=1285 child-days)

	Food Group (% contribution)						
	Grains group	Dairy	Flesh Foods	Eggs	Fruits & vegetables	Legumes & Nuts	Fats & oil
Energy	54.18	19.12	4.70	4.07	1.70	1.62	0.79
Vitamin A	4.55	71.77	10.99	11.18	0.68	0.04	0.03
Thiamin	12.97	8.39	1.43	1.41	73.85	0.88	0.31
Riboflavin	20.65	50.63	7.27	10.45	0.65	1.07	5.06
Vitamin B6	46.16	18.95	11.26	9.56	11.80	0.31	0.11
Folate	86.53	4.43	0.36	6.66	1.86	0.04	<0.01
Vitamin B12	10.14	29.29	3.90	54.20	0.	0.	0.02
Vitamin C	26.40	33.10	0.29	0.	37.66	1.24	<0.01
Absorbed calcium	16.49	59.66	3.43	4.12	1.88	8.13	0.02
Absorbed iron	25.82	24.55	16.18	22.58	1.16	2.04	3.97
Absorbed zinc	45.34	30.86	7.57	12.68	1.62	0.09	0.15

Table 5. Percent contribution of food groups to energy and nutrient intake from food, for nonbreastfed children aged 6-11 mos (n=1369 child-days)

	Food Group (%)						
	Grains group	Dairy	Flesh Foods	Eggs	Fruits & vegetables	Legumes & Nuts	Fats & oil
Energy	41.71	37.19	2.07	2.67	1.12	0.78	0.61
Vitamin A	3.15	87.59	4.20	4.64	0.21	0.01	0.03
Thiamin	11.89	20.65	0.93	1.15	63.49	0.48	0.26
Riboflavin	11.93	74.44	3.34	5.25	0.25	0.40	2.48
Vitamin B6	35.70	42.15	7.90	6.04	7.83	0.09	0.07
Folate	80.51	12.44	0.31	5.29	1.37	0.06	0.
Vitamin B12	10.70	55.05	2.58	31.18	0.	0.	0.01
Vitamin C	14.51	66.05	0.12	0.	18.53	0.33	0.
Absorbed calcium	9.94	81.27	1.08	1.92	0.84	2.70	0.01
Absorbed iron	18.78	53.54	8.76	13.55	0.62	0.84	2.35
Absorbed zinc	31.35	55.70	4.50	7.03	0.93	0.09	0.08

Relationship between MMDA and Food Group Diversity

Mean micronutrient density adequacy (MMDA) values are significantly lower over-all (GLM test for repeated measures $p < 0.001$, 95% CI 14.118, 19.212) for breastfed infants (~50%) than for the non-breastfed (~59%), particularly for the 6 to 8 month olds (BF 48% vs NBF 68%). The highest MMDA (68%) is for the younger non-breastfed infants. The ranges are quite wide for all groups, regardless of age or breastfeeding status (from about 0.3 to 100), but are widest for the younger breastfed infants.

Is the diet diversity indicator (DD) associated with the nutrient adequacy measure (MMDA)?

MMDA values tend to increase with the number of food groups eaten. As expected, the MMDAs of the younger (6 to 8 month old) breastfed infants are lower than those of the older 9 to 11 month olds for any number of food groups eaten. Such was not the case for the non-breastfed, where MMDAs are almost always lower in the older age group. Moreover, for these older NBF infants, MMDA flattens out as DD increases (Figure 2). Breastfed infants, in general, have lower MMDAs than the non-breastfed, regardless of age group, and number of food groups eaten.

MMDA and the food group diversity indicator (Table 6) are significantly correlated with the correlation being stronger (the coefficients are much larger) among the breastfed relative to the non-breastfed.

Table 6. Relationship between Mean Micronutrient Density Adequacy (MMDA) and food group diversity by breastfeeding status

	n	MMDA (mean)	DD (mean)	Correlation coefficient
<u>Breastfed</u>				
6-8 mos	703	47.75	2.02	0.625**
9-11 mos	582	52.26	2.19	0.662**
All BF (6-11 mos)	1285	49.79	2.10	0.643**
<u>Non-breastfed</u>				
6-8 mos	665	67.79	2.60	0.254**
9-11 mos	704	65.99	2.78	0.336**
All NBF (6-11 mos)	1369	66.86	2.69	0.285**
<u>All children</u>	2654	58.60	2.40	0.523**

**correlation is significant at the 0.01 level (2-tailed)

What is the effect of fortified intake on the relationship of the diet diversity indicator with nutrient adequacy?

The distribution of child-days of observations with fortified food and infant formula intake among the infants by age and breastfeeding category (Table 7) shows that a total of 658 child-days representing 24.8% of observations had intake of a fortified product.

Table 7. Fortified food and milk intake distribution of child-days of observation by breastfeeding and age categories

	Total child-days	No intake of fortified product n (%)	Fortified food intake n (%)	Fortified milk intake n (%)
Breastfed				
6 to 8 months	703	584 (83.1)	34 (4.8)	85 (12.1)
9 to 11 months	582	538 (92.4)	11 (1.9)	33 (5.7)
All BF (6 to 11 months)	1285	1122 (87.3)	45 (3.5)	118 (9.2)
Non-breastfed				
6 to 8 months	665	356 (53.5)	35 (5.3)	274 (41.2)
9 to 11 months	704	518 (73.6)	33 (4.7)	153 (21.7)
All NBF (6 to 11 months)	1369	874 (63.8)	68 (5.0)	427 (31.2)
All children (breastfed or not)	2654	1996 (75.2)	113 (4.3)	545 (20.5)

In assessing the relationship between food group diversity and nutrient adequacy, a significant interaction effect was found between the diet diversity indicator (DD) and fortified intake ($p < 0.0001$ for fortified milk, $p = 0.03$ for fortified foods).

The regression model predicting MMDA with the diversity score as the predictor is strengthened by the inclusion of the fortified intake variable, either as a main effect alone or all together as an interaction term, with the r-squared increasing from 0.27 (with the diversity score alone) to 0.59 when the fortified dummy variables (fortified food, and fortified milk) are included in the equation and to 0.63 with the complete model (with the interaction terms).

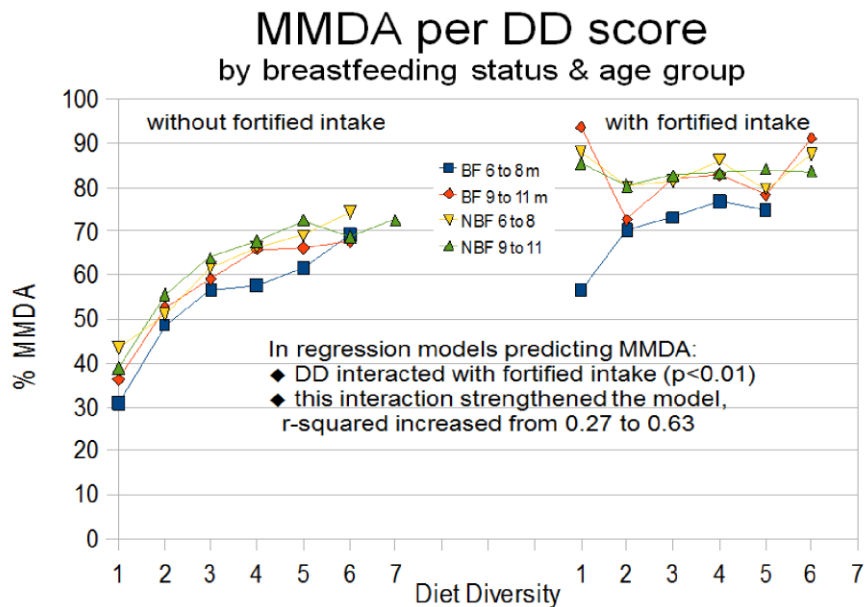


Figure 2. Distribution of % MMDA by DD score on days with and without fortified intake

Further examination of how fortified intake affects the relationship between diversity and MMDA shows that on child-days where no fortified product was taken diversity increases as MMDA increases (Figure 2). However, for the child-days with fortified intake, MMDAs are much higher across the board, with ranges from 57% to 93% (compared to 31% to 76% for no fortified intake days, Table 8) and the relationship between the two flattens out.

On days with fortified intake, as may be expected, the correlation coefficients (between MMDA and diversity) are lower (Table 8), and are not significant for the non-breastfed sub-groups who are consuming fortified products. This is in contrast to the highly significant correlations between MMDA and DD in all the subgroups in the aggregated analysis.

Mean diet diversity indicators are higher for the days with fortified product intake for the breastfed infants (ranging from 2.4 to almost 3 compared to 1.9 to 2.1 for those with no intake), but these remain about the same for the non-breastfed regardless of this disaggregation.

Table 8. Days with Fortified Product Intake, Relationship between Mean Micronutrient Density Adequacy (MMDA) and food group diversity by breastfeeding status

	Without Fortified Product Intake				With Fortified Product Intake			
	n	MMDA (mean)	DD (mean)	Correlation coefficient	n	MMDA (mean)	DD (mean)	Correlation coefficient
<u>Breastfed</u>								
6-8 mos	584	43.37	1.94	0.673**	119	69.24	2.40	0.494**
9-11 mos	538	50.04	2.12	0.681**	44	79.34	2.98	0.222
All BF (6-11 mos)	1122	46.57	2.03	0.677**	163	71.97	2.56	0.471**
<u>Non-BF</u>								
6-8 mos	356	55.88	2.58	0.556**	309	81.52	2.62	0.056
9-11 mos	518	60.33	2.77	0.516**	186	81.73	2.80	0.098
All NBF (6-11 mos)	874	58.52	2.69	0.538**	495	81.60	2.69	0.071
<u>All children</u>	1996	51.80	2.32	0.663**	658	79.22	2.66	0.182**

**correlation is significant at the 0.01 level (2-tailed) note: all relationships are nonlinear

Discussion

The diets of the infants in this study are overwhelmingly inadequate no matter how one describes it, whether by the diversity of food groups, by a diversity score (DD), or by actual nutrient ingestion as measured by the Mean Micronutrient Density (MMDA). As will become apparent in this discussion, other information is necessary to interpret this finding for the uses for which the DD is recommended.

“Dietary diversity is a proxy for adequate micronutrient-density of foods. Dietary data from children 6–23 months of age in 10 developing country sites have shown that consumption of foods from at least 4 food groups on the previous day would mean that in most populations, the child had a high likelihood of consuming at least one animal-source food and at least one fruit or vegetable, in addition to a staple food ”(WHO, 2010). From a statistical perspective the overwhelming inadequacy means that lack of associations are not attenuated because of a ceiling effect.

In examining the relationship of the DD’s to the MMDA one must take into account that the diets of breastfed and non-breastfed infants in this population are distinguished by the foods that dominate daily intake. Although both groups invariably consume rice, the non-breast-fed’s diet are characterized by the intake of dairy (Table 2), a substantial amount of which is taken in the form of infant formula.

However, the distribution of food categories per score is similar for breastfed and non-breastfed, except for one striking difference. Foods from the dairy category are the most frequently ingested

foods for the non-breast fed, while this is not so for the breastfed. This is not surprising because the dairy foods replace breast milk, but it affects the interpretation of the scores enormously. For instance a score of 0 has a different meaning for breastfed who may be relatively well nourished, because they receive breast milk, than for the non-breast fed whose nutrient intake is zero. The present WHO scoring system tries to avoid this confusion by analyzing the breast-fed and non-breast-fed children separately. It would, however, be both conceptually more correct and practically much safer to make breast milk a food group in its own right to avoid confusion.

The argument against adding breast milk, as a food category, is that the DD is intended to measure the contributions of complementary feeding to the diet. However, for this analysis, where the aim is to assess DD's relationship to dietary adequacy, it appears ironic that while bottled milk is counted, breastmilk's contributions are not accounted for in the DD score.

The MMDA's increased significantly (Table 11) in a more or less linear fashion from about 40 for those with a DD score 1 to about 70 for those with a DD score of 6 for infants who did not ingest fortified foods (Figure 1). For infants who consumed fortified foods this effect was much attenuated for 6-8 m and completely disappeared for all the others (Table 11). The slopes between fortified and non-fortified foods were significantly different (Table 10). The reason for the attenuation is that infants with low scores are consuming foods which are fortified, and there is less fortification in the added foods consumed at higher DD values (Table 9), so the difference between breastfed and non-breastfed infants diminishes. However, the difference in favor of infant eating fortified foods is still substantial even at the highest DD levels (Figure 2).

The finding that fortified foods attenuate the relationship between DD and MMDA is important because the feeding guidelines (WHO/PAHO, 2003) include a recommendation to give children fortified foods. In the context of assessing the implementation of these feeding guidelines as a whole, it may be not be appropriate to use the diversity score as a marker of micronutrient intake without flagging fortified foods.

This becomes particularly important when assessing the effects of including technologically improved diets either through ready-use-fortified foods, or adding micronutrients through sprinkles or foodlets as one would see no impact on diet diversity despite substantial improvements in micronutrient adequacy.

The Philippines has recently passed a law⁴ requiring staples like rice, flour, sugar and oil to be fortified with either Vitamin A or iron or both. With the full implementation of this law, the relationship between the diet diversity score and micronutrient adequacy will be further attenuated in this country. The Philippine government has, in addition, put in place programs for the mass supplementation of Vit. A for children 6 to 71 months, and iron supplementation for selected sub-groups (DOH, 2004). Micronutrient supplementation, while not considered part of the diet, does contribute to micronutrient adequacy, through the same outcome and health/nutrition pathway that a measure like MMDA does. Therefore, the DD cannot be used to infer MMDA where fortification is wide spread.

In considering the relative importance of food categories to MMDA (Table 4) as DD increases by one score, one is struck by the similar sequence of the contribution of each food category with

4 RA 8976. Philippine Fortification Act of 2000.

increases in DD score for both breast fed and non- breast fed, IF Breastmilk were a food category. At the lowest score Breast milk or Dairy are consumed the most followed closely by Grains, roots and tubers. By the next score up (now 1 for breast fed and 2 for non-breast fed) almost all children are consuming both. At higher scores, flesh foods are consumed more and more with increasing DD score. This is also true to a lesser degree of the other food categories. On this basis one could consider any DD higher than 3 for the breastfed and 4 for the non-breastfed as sufficiently diversified for most children except for legumes, nuts, fruits and vegetables, which only rise to satisfactory levels at higher DD scores. The major rise of MMDA associated with DD also occurs up to the 3 or 4 cut-off and levels off thereafter. Our findings thus concur with cut-offs of 3 for breastfed and 4 for the non-breastfed as applied in DHS (Philippines DHS 2008). However, most children were far below these cut-offs and the MMDA values are still inadequate above the cut-offs, even at the highest DD scores.

The low MMDAs even at high DD scores is a cause for concern as it implies that merely adding food groups is not enough to ensure nutrient adequacy in this setting. Fortification has a big potential to improve this situation, in which case, DD may not be a sufficient indicator.

The MMDA score of the younger (6-8m) breastfed children is a third lower than that of the non-breast fed (Table 5). The difference falls to 20% in the older infants, which is a reflection of the decreasing contribution of fortified products in the diet. However, this difference still represents a major contribution of breast milk to the diet, if the 20 % difference is a good measure of the contribution of breast milk to the MMDA score . These estimates of the contribution of breast milk to the MMDA are overstated when the difference between the non-breastfed and the breastfed is due to

fortified foods as is the case for the younger (6-8m) non-breastfed infants with the lowest diversity score of 1. They only ingest dairy, which is made up of highly fortified formula, so their MMDA scores are 43% higher than the breastfed infants with a score of 1 who are eating cereal.

The potential for confusion with different DD score cut-offs between breastfed and non-breastfed is already apparent in the way the IYCF indicators have been applied to the Philippine DHS 2008, which uses 3 as the minimum acceptable DD for breastfed and 4 for the non-breastfed. However, in the WHO 2010 IYCF document on measurement of indicators, there is no distinction between breastfed and nonbreastfed – a situation which could further complicate the interpretation of these indicators as discussed above.

Conclusion

The DD score relates to the MMDA in general. However, even the highest DD scores do not correspond to adequate MMDA, but those below 3 for breastfed and 4 for non-breast fed are clearly inadequate. These cut-offs correspond to those currently in use for the DHS, but should not be interpreted as indicating adequate nutrient intake for those above the cut-offs.

The DD scores are not useful for infants where much of the dairy and cereal foods are fortified because these are the major sources of energy for all the DD levels, including the lowest. The DD scores should not be used where fortification and supplementation is wide spread in the population because the relationship between DD and MMDA is attenuated where there is substantial fortified product intake.

For non-fortified populations, adding breast milk as a food category would improve interpretation. There would be one and the same cut-off for both breastfed and non-breastfed children. It will also prevent the false perception that breastfed children are worse-off (because they will always have a lower score relative to the nonbreastfed) , with a potentially negative effect on the promotion of breast-feeding. This mistake will become increasingly common as the recommendation is forgotten that the DD scores must be interpreted differently for breastfed and non-breastfed children. Therefore we recommend that the breast milk be coded as a food category,

Chapter 3

Diet diversity, but not meal frequency nor the individual food groups, is associated with growth in Filipino infants 6 to 11 months old

Abstract

Background: Infants and young children in resource-constrained settings are most vulnerable to undernutrition during the complementary feeding (CF) period.

Objective: This paper contributes to the evolving understanding of the use of CF indicators by testing the association of diet diversity (DD), meal frequency (MF) and individual food groups with longitudinal growth.

Design: Data from anthropometric determinations and 24 hour food recalls (collected monthly from 6 to 11 months) of 255 Filipino infants from a poor urban area were analysed separately for NBF (n=135) and BF (n=120) infants. Longitudinal growth was measured as the residual of weight-for-age (waz) at 11 months when regressed on waz at 6 months, which excludes influences mediated through attained growth at 6 months.

Results: Food groups, with and without MF in the model, are poor predictors of longitudinal growth. In contrast, their aggregation into a DD score is a better predictor by itself (DD: $\beta=0.281$, $p=0.002$) and when combined with MF (DD: $\beta=0.241$, $p=0.005$; MF: $\beta=0.095$, $p=0.332$) for BF infants. For the NBF, DD predicts longitudinal growth only when it is by itself (DD: $\beta=0.167$, $p=0.05$) in the model.

Conclusions: We conclude that DD does predict longitudinal growth in this setting and age group, but the addition of MF weakens this predictive association particularly for the non-breastfed. DD and MF as components of a CF summary indicator, unlike the breastfeeding indicators, have limited applications in terms of links to actionable behaviors and for advocating diet-related policy change.

Introduction

The growing body of evidence-based knowledge about complementary feeding (CF) has contributed to an emerging consensus about what constitutes adequate infant and young child feeding (IYCF) and facilitated agreement on the codification of guidelines for breastfed children (WHO/PAHO, 2003⁷⁴) and non-breastfed children (WHO, 2005⁷⁵). The availability of guidelines, in turn, increased the feasibility of constructing a set of indicators that could be applied across national, regional and cultural contexts to assess the status of populations and measure progress toward goals, such as the Millennium Development Goals (MDG Target 1.C⁷⁶). Under the guidance of WHO and UNICEF, a set of indicators of infant and young child feeding practices (WHO et al 2008⁷⁷) and a method for calculating them (WHO et al 2010⁷⁸) has recently been finalized and released. The development of the indicators involved a multi-year, multi-institution and multi-country process, which included analyses of data sets from 10 countries. The primary author of this paper participated in this process, providing data and analyses from a peri-urban population in the Philippines.

The purpose of this paper is to examine the performance of the components of the summary indicator, in relation to child growth in the Philippine sample. The summary indicator consists of two components – dietary diversity (DD) and meal frequency (MF). The WHO/UNICEF IYCF indicator development process used a calculated measure of nutrient adequacy, rather than anthropometry, as the standard against which to assess the associations with a biological outcome (reference Nutrient Analysis paper). However, for purposes of local policy and planning, as well as program implementation, it is important to understand how the indicators relate to growth. A feature of the Philippine data set that contributes to its utility for assessing indicator performance is that the data,

which cover the period from 6 to 11 months of age, are longitudinal. This makes it possible to examine the effects of the food groups, the DD and the MF scores on cumulative growth from 6 to 11 months, excluding the influences of confounding factors mediated through previous growth up to 6 months.

Background

Dietary Diversity

Dietary diversity (DD) is the primary component of the CF indicator. The concept of dietary diversity as a global measure of dietary quality has a long history in nutrition and food research (Dewalt, Kelly and Pelto 1980⁷⁹; Bentley and Pelto 1991⁸⁰, Kant 1996⁸¹ Ruel, 2003⁸²). It is based on a fundamental feature of the distribution of nutrients in foods, namely that specific nutrients tend to cluster in different food groups. For example, fruits and vegetables tend to be higher in vitamins, animal foods are higher in proteins, fats and minerals, while grains are sources of carbohydrates. Thus, a “balanced diet,” which draws from multiple food groups, is associated with an increased likelihood of consumption of all essential nutrients. Over the years various formulations of dietary diversity have been proposed and tested (Ruel, 2003). The method (Arimond et al, 2005⁸³) used in the WHO/UNICEF indicator is the first systematic, comprehensive effort to codify this concept for CF.

Meal Frequency

Measures of types of foods consumed are insufficient descriptors of adequacy of intake because they do not contain any measure of quantity. Quantity is obviously a fundamental aspect of assessing nutritional adequacy for anyone, but it is particularly important for complementary feeding, where

deficiencies in the amount infants and young children are fed is a major source of undernutrition (Brown, Dewey & Allen, 1998⁸⁴). Short of direct observation and weighing, or detailed questioning to obtain respondents' estimates of portion size, another method for obtaining an estimate of quantity is to determine the number of times food is eaten over the course of the day. The WHO/UNICEF indicator uses a measure of meal frequency (MF) to account for the quantitative component in CF.

Food Groups

Dietary diversity scores are composite measures, typically derived from a process in which individual food items are first aggregated into food groups. In practice, this aggregation may take place during the course of data collection so that respondents are asked about consumption of food groups rather than individual food items. The logic of DD scores implies that the number of food groups consumed can be used to assess the adequacy of CF. This paper evaluates this potential using growth as the outcome in the Philippines. The method used in this paper may be used elsewhere to assess the utility of DD in other countries or regional settings.

Methods

Data source and study population

The data used in these analyses are from the Research Institute for Tropical Medicine's (RITM) Infant Feeding Intervention Study (IFIS, Saniel et al, 1993⁸⁵). They were collected from 1986-1988 as part of a pre-intervention survey for an intervention aimed at improving infant feeding and diarrhea management in Muntinlupa, a peri-urban town about 25 km south of Manila. Muntinlupa is

an industrial and transportation hub that serves as a major gateway between Manila and southern Philippine provinces.

A census was conducted to identify potential households for the study who met the criterion of very low economic status, based on the construction materials (make-shift or non-permanent) of their dwellings. As births occurred within the study area, all infants were screened and recruited if they met the following criteria: 1) dwelling units made of makeshift, nonpermanent materials, 2) birth weight at least 2.5 kg (as weighed by the study team's field staff within 48 hours of birth), 3) gestation at least 37 wks (based on maternal recall of last menstrual period (LMP), 4) singleton, 5) normal delivery, 6) absence of congenital malformation that could affect feeding and 7) informed consent from parents.

Data collection

Trained interviewers conducted monthly home visits to collect data. Anthropometry and feeding data (24 hour recall) were obtained within 3 days of the monthly birthday from birth to one year. To ensure data quality, supervisors carried out spot checks and random repeat interviews. Mothers were asked to recall the infant's diet for the last 24 hours, including the following: frequency of breastfeeding and giving of milk and milk substitutes, kinds of liquids and solids given, as well as frequencies and amounts recorded in household measures, cooking process and ingredients. Local household utensils and paper drawings were used for approximating sizes and amounts. Measurements of intake were obtained of cooked foods, if the food was consumed cooked, and in raw form if consumed raw. Data from infants who were ill during the follow-up visit were analyzed separately, and excluded from this analysis.

Variable definition

Feeding Status

In these analyses infants were classified as breastfed if they continued to breastfeed throughout the 6 to 11 month period, and nonbreastfed if they were not breastfed at all during this period. Infants who shifted breastfeeding patterns during the 6 months were excluded from this analysis in order to avoid potential confounding effects of these shifts.

Food group and dietary diversity variables

Food group definitions were based on those of the Working Group on Infant and Young Child Feeding Indicators (WG-IYCFI) (Arimond, et al 2005). The food groups⁵ are: 1) flesh foods (meat, fish, poultry, organ meats), 2) eggs, 3) dairy products (milk, infant formula, cheese, cream), 4) grains/roots/tubers, 5) legumes/nuts (beans, peas, soy, nuts, seeds), 6) fruits and vegetables, and 7) fats/oils. For each month intake of a minimum of 1 g of any food belonging to a food group, a score of “1” for that group was assigned ; less than 1 gram was given a food group score of 0.

To obtain a composite score for each food group the values for each month, from age 6 months through 11 months, were summed. The potential range of values for the composite score of a food group is 0 to 6.

5 None of the foods consumed by the infants met the criteria for an 8th food group of Vitamin A-rich fruits and vegetables defined as foods containing 130 RE/100 g EP at 1:12 RE:beta carotene conversion. Hence for this study, fruits and vegetables are all in one group. A modification of the IYCF indicators has re-defined this 8th food group to be one of iron-rich foods. The fats and oils group has been dropped from the final food groups because of difficulty in assessing intake.

To obtain a monthly dietary diversity (DD) score, the number of food groups in the month were summed. The DD score for any month could range from 0 for exclusively breastfed children to 7.

To obtain a composite (cumulative) DD score, the monthly DD scores were added, from age 6 months through age 11 months. Assuming that no child could be exclusively breastfed to 12 months of age, the theoretical range of DD scores is from a low of 1 to a high of 42, the latter representing a case in which a child received at least 1 gm of food from all 7 food groups for the full 6 month period. Exploratory analyses revealed similar effects of DD on growth across the monthly intervals, so the full 6 month period was used.

Meal frequency (MF) was obtained from the answers to a specific interview question, rather than being derived from the 24 hour food recall records. After each 24 hour recall was collected caregivers were asked how many times the child was given food in the previous day. For each month, the MF variable is the response to this question. The composite score for the 6 months is the sum of the 6 monthly scores.

Anthropometric status

As birth date was known precisely for all children in the sample, weight-for-age (WAZ) and height-for age (HAZ) Z-scores could be directly calculated for the children using the WHO Child Growth Standards (CGS) (de Onis, 2006⁸⁶)

Sample size

The sample for this paper consists of 255 infants with complete dietary and anthropometric data for the period from 6 through 11 months of age and whose feeding status (breastfed or non-breastfed) did not shift over this period of time. Forty-five children from the full study sample of 300 were excluded from the analyses because their breastfeeding status changed between 6 and 11 months.

Analytic procedures

The analyses were carried out with SPSS v.14 using the 11 month WAZ as the growth outcome measure. Since we wanted to examine the relationship between DD and MF between 6 and 11 months with growth, we needed to control for growth prior to 6 months of age. To achieve this we obtained the residual WAZ value for 11 months using the method suggested by Esrey, Casella and Habicht (1990⁸⁷) which excludes influences mediated through attained growth at 6 months.

The residual, RES, was calculated by subtracting the infant's actual weight at 11 months, WAZ_i from the 11 month weight (\hat{WAZ}_i) estimated from that infant's 6 month WAZ using the parameter a and b from an equation derived from all the infants in the sample.

Thus:

$$RES = WAZ_i - \hat{WAZ}_i$$

$$\hat{WAZ}_i \text{ 11 months} = a + b WAZ_i \text{ at 6 months} \rightarrow RES$$

The relationship of diet diversity score (DD) to growth was calculated as :

$$RES = a + b_1 DD$$

Similarly, the effect of adding the frequency of feeding, MF, was examined with the following:

$$\text{RES} = a + b_1 \text{DD} + b_2 \text{MF}$$

Food groups were related to growth as :

$$\text{RES} = a + b_1 \text{flesh foods} + b_2 \text{eggs} + b_3 \text{dairy} + b_4 \text{grains, roots, tubers} + b_5 \text{legumes, nuts} + b_6 \text{fruits, vegetables} + b_7 \text{fats, oils} + b_8 \text{frequency of feeding} + e$$

The slopes (b_n) were estimated by the standardized regression coefficients, $\beta = b/\text{standard error of } b$, which is unit-less, and therefore directly comparable across variables that have different units.

The statistical significance of the regression was assessed by a two tailed t-test, with $p < 0.05$ of the square of the correlation coefficient, R-squared Adjusted R-squares, was used in the comparisons when the equations had more than one independent variable, (Norusis, 2003⁸⁸). In addition, the DD models, with and without MF were compared with an F test (for nested models) to assess whether one model fitted the regression line better than another (Motulsky & Christopoulos, 2004⁸⁹).

Ethical Considerations

This was an analysis of secondary data and the data set had been stripped of all identifiers for this purpose. The primary author was a member of the original study team and obtained the consent of the principal investigator and the administration of the institute. The original study protocol had been reviewed by the RITM Ethics and Technical Review Board. The protocol for this analysis was reviewed by the Cornell University Committee on Human Subjects Research and classified as “exempt.”

Results

Dietary Diversity

Dietary diversity scores, by month, are shown in Table 9, together with the 6-month cumulative score. In this table the values are shown separately for breastfed and non-breastfed in order to ensure that differences associated with feeding mode did not obscure the picture of dietary patterns.

For breastfed infants, the average number of food groups (dietary diversity) ranged from 1.8 to 2.48. The cumulative score (6-11 months) was 12.91, equivalent to a monthly mean of 2.15. For non-breast fed children, the picture is quite similar. The average DD score ranged from 2.32 to 3.07. The cumulative score (6-11 months) was 16.16, with an average monthly mean of 2.69.

Meal Frequency

Meal frequency (MF), as seen in Table 9, increased steadily over the course of the 6 months, for both breastfed and non-breastfed children. . Infants generally were fed between 3 and 4 times per day, in which 2 to 3 of the feeding episodes were defined by the mothers as “meals” and 1 to 2 were described as “snacks.” As a consequence of mothers’ interpretation of the question, in which liquids are not seen as food (ref Mothers' groups paper), it measures the frequency with which solid and semi-solid foods were given, but does not include the milk feeds given to non-breastfed infants.\

Table 9. Dietary Diversity score, Meal Frequency score and Weight-for-age Z score by breastfeeding status and month of age

Month of age							
Breastfed (n = 120)							
	6	7	8	9	10	11	Cumulative Score
Dietary Diversity Mean (SD)	1.8 (0.98)	2.12 (1.04)	2.18 (1.14)	2.26 (1.08)	2.48 (1.15)	2.08 (0.95)	12.91 (4.42)
Meal Frequency Mean (SD)	2.6 (1.11)	3.09 (1.1)	3.19 (1.23)	3.30 (1.13)	3.49 (1.12)	3.58 (1.11)	19.25 (4.72)
Weight-for-Age Z	-0.39 (0.88)	-0.54 (0.90)	-0.67 (0.88)	-0.73 (0.89)	-0.87 (0.91)	-0.94 (0.90)	
Non-breastfed (n = 135)							
	6	7	8	9	10	11	Cumulative Score
Dietary Diversity Mean (SD)	2.32 (0.84)	2.64 (0.93)	2.73 (1.06)	2.78 (0.94)	3.07 (1.18)	2.67 (0.95)	16.16 (3.94)
Meal Frequency Mean (SD)	2.4 (1.30)	2.77 (1.34)	3.09 (1.30)	3.44 (1.20)	3.46 (1.07)	3.61 (1.26)	18.78 (5.26)
Weight-for-Age Z	-0.72 (0.97)	-0.76 (0.99)	-0.78 (0.98)	-0.78 (0.99)	-0.83 (0.99)	-0.79 (0.98)	

Weight-for-Age Z-Scores.

Table 9 also shows the mean WAZ values from 6 through 11 months. The infants in this sample were born at birth weights very close to the international mean. For the breastfed group, WAZ had declined modestly to -0.39 by 6 months of age. However, their weight continued to decline steadily and was -0.94 by 11 months of age. The non-breastfed children have substantially lower WAZ at 6 months, compared to the breastfed children, but their weight status, relative to the international standard remains essentially unchanged over the 6 month period.

Food Groups

Table 10 provides the data on food group consumption patterns. For each month of age the percent of infants who received one or more foods from each group is shown. Here we see that for breastfed infants, the most common complementary foods came from the Grains food group throughout the 6 month period. Dairy foods were a distant second source, with less than a third of infants receiving dairy foods in any one month, until 11 months, when the percent rose modestly to about 41.67%. Flesh foods began at a low level and increased over time, peaking at 10 months and then declining somewhat. The other food groups – fats and oils, fruits and vegetables, legumes and nuts, and eggs - appeared in a minority of the dietary records.

Table 10. Food Group Consumption (% of children) by breastfeeding status and month of age

Month of age							
Breastfed (n=120)							
Food Groups	6	7	8	9	10	11	Average Cumulative Score
grains, roots and tubers	96.67	99.17	100.00	100.00	100.00	98.33	5.94
dairy	28.33	30.00	30.00	34.17	32.50	41.67	1.97
flesh foods	11.67	25.00	22.50	33.33	42.50	26.67	1.62
fats and oils	11.67	18.33	26.67	29.17	40.00	20.00	1.46
fruits and vegetables	18.33	20.83	25.83	22.50	21.67	14.17	1.23
legumes and nuts	10.83	18.33	16.67	14.17	20.00	17.50	0.98
eggs	10.00	12.50	18.33	20.00	18.33	10.00	0.89
Non Breastfed (n=135)							
Food Groups	6	7	8	9	10	11	Average Cumulative Score
dairy	98.52	97.04	97.78	97.78	97.78	98.52	5.87
grains, roots and tubers	89.63	94.81	96.30	99.26	99.26	98.52	5.78
flesh foods	11.11	22.22	25.93	28.89	39.26	22.96	1.5
fats and oils	7.41	14.07	22.96	27.41	28.89	20.00	1.21
fruits and vegetables	14.07	17.78	21.48	19.26	22.96	17.78	1.13
legumes and nuts	10.37	14.81	16.30	16.30	25.19	17.78	1.01
eggs	5.93	11.85	12.59	13.33	10.37	8.15	0.62

The final column on the right shows the average cumulative score for a food group. As a constructed variable, its value could vary between a minimum of 0 and a maximum of 6, the latter

representing the use of a food group in all 6 months. For example, the score of 6 for Grains means that infants were given a food or foods from the Grains food group in every month of the study. The low scores for the other groups indicate that these foods were not a significant part of infant diets. That none of these values are 0 reflects the fact that some infants did receive these foods at some point over the course of the 6 months.

For non-breastfed infants, as expected, almost 100% of infants received foods from the dairy group in each of the months from 6 to 11 months as these are serving as breastmilk substitutes. As with breastfed infants, nearly all of them were receiving foods from the Grains food group, almost all of the time. The patterns for the other food groups were very similar to those of the breastfed, with Flesh foods beginning at a low level and increasing over time, peaking at 10 months and then declining. Again, the other food groups – fats and oils, fruits and vegetables, legumes and nuts, and eggs – appeared in a minority of the dietary records.

Testing the hypothesis

Table 11 provides the results relating DD to growth. For breastfed infants, the correlation of DD to growth from 6-11 months was strongly significant ($p < 0.002$). The adjusted R-Squared is 0.071 indicating that about 7 percent of the variability in weight was accounted for by dietary diversity. MF alone was also significantly associated with WAZ ($p < 0.032$). When MF is added to DD the p value for the model remained highly significant (.005) but was slightly less than the model with DD alone.

For non-breastfed infants the association of DD with 11 month weight was at the borderline of statistical significance ($p < 0.054$). The adjusted R squared was 0.021.

MF was not significantly related to 11 month weight ($p < 0.099$). When MF was added to the model with DD, the model was well below the cut-off for statistical significance (0.156) and the adjusted R squared dropped to 0.13.

Table 11. Predictive models for WAZ with Dietary Diversity and Meal Frequency

	Breastfed			
Predictors	Regression Coefficients		Model	
	Std β	p of predictors	r sq , adj r sq	p of model
DD alone	0.281	0.002	0.079, 0.071	0.002
MF alone	0.196	0.032	0.038, 0.030	0.032
DD with MF	DD: 0.241 FF: 0.095	DD: 0.015 FF: 0.332	0.086, 0.071	0.005
	Non breastfed			
DD alone	0.167	0.054	0.028, 0.021	0.054
MF alone	0.099	0.253	0.01, 0.002	0.253
DD with MF	DD: 0.171 FF: -0.006	DD: 0.123 FF: 0.960	0.028, 0.013	0.156

The results of univariate models examining the relationship between individual food groups and RES, growth in WAZ from 6 to 11 months, is shown in Table 12. None of the models in these analyses were statistically significant, indicating that no individual food group was a significant determinant of growth. One can also see in this table that the largest betas were notably different for the breast fed and the non-breast fed infants.

We conducted stepwise multivariate regressions, separately for breastfed and non-breastfed children. For the breast fed children, only one predictor – Flesh foods – remained in the model with $\beta = 0.210$, and a $p = 0.021$. For the non-breast fed no food group entered the equation at $p < 0.05$.

Table 12. Food Groups: regression models for 11-month WAZ, by breastfeeding status

Food Groups	Breastfed		Non-breastfed	
	Std β	Adj r-sq	Std β	Adj r-sq
flesh foods	0.210	0.036	0.125	0.008
eggs	0.071	-0.003	0.145	0.014
dairy	0.179	0.024	0.024	-0.007
grains	0.040	-0.007	0.139	0.012
legumes	0.074	-0.003	0.087	<0.0001
fruits & veg	0.112	0.004	0.027	-0.007
fats, oils	0.207	0.035	0.136	0.011

Discussion

The analyses presented here represent a slice out of the larger period of IYC feeding over the course of infancy and early childhood. Six to eleven months is the period when complementary feeding begins; it is the time when children are most likely to receive special complementary foods, as well as household foods that are modified for their consumption. The fact that this paper focuses exclusively on this slice of time is essential for interpreting the results and for comparing them with other studies that summarize results across the full period of complementary feeding.

Dietary diversity

The results of this study validate the nutritional-biological premises underlying the construction of the DD indicator. A positive association between the indicator and growth in WAZ in the second semester of life reveals that even in this early period of complementary feeding, greater diversity in the diet increases the consumption of nutrients that are essential for growth. Other studies in other parts of the world, using cross sectional data have also confirmed this relationship and its extension into early childhood (Arimond & Ruel, 2004⁹⁰; Ruel & Menon, 2002⁹¹, Steyn et al, 2005⁹²)

Meal Frequency

A second main finding is that meal frequency did not add substantial information to the indicator. For breastfed children the association was positive and statistically significant, but including it in the predictive equation reduced the association with growth. For the non-breastfed infants it detracted significantly from indicator performance. For this group the association between DD and growth was

on the margin with respect to statistical significance. Adding it to the predictive equation introduced so much noise to the measurement that the combined model fell well below a cut-off for statistical significance.

Part of the explanation may be a technical problem with our measurement of MF. As described above, it did not include separate milk feeds. This reduced the total MF score for the non-breastfed infants. If children who were growing better received more separate milk feeds than those who were doing less well, this difference would not be reflected in the MF score and this flattening in the MF score may explain why it reduced the indicators performance. However, this does not explain why it was also problematic in the BF group in that including it in the predictive model weakened, rather than strengthened the association. One possible explanation is that the effects of MF on the growth of BF infants are already explained by DD so that adding MF detracts from the strength of the model.

Food Groups

The finding that individual food groups were not associated with growth was unexpected and disappointing. The analysis presented here indicates that the global effect of DD is capturing something different from individual food groups. However, as dietary diversity is created through the consumption of foods from different food groups, and as food groups differ in their nutrient composition, one might have expected that some food groups are more important than others in supporting growth in infancy. If consumption from the less commonly consumed groups explained why some infants were doing better than others, then those food groups should have had higher associations with growth, but they did not. This finding does not rule out the potential that individual foods within these groups might nonetheless be driving the association of growth with DD. If that is

the case then a focus on identifying and measuring the role of “sentinel foods” is an important next step from the perspective of developing both location-specific and cross-regional measures of good feeding practices.

One group with this potential to be a sentinel food, at least in this population, are flesh foods, which did emerge as the only food group that remained in the stepwise model, but only among breastfed infants. For the non-breastfed, flesh foods may not be contributing anything beyond what dairy already is, hence no food group emerges as a possible sentinel. This warrants further investigation.

Breastfed and non-breastfed infants. The differences between breast fed and non-breast fed are notable. First, it is apparent that the DD will probably always be higher because non-breastfed infants are, almost by definition, receiving foods from two food groups – Dairy and Grains. This means that it is essential to analyse indicators separately for breast fed and non-breast fed. The indicators already do this, and this finding simply reinforces the wisdom of insisting on the distinction. It also reinforces the importance of ensuring that country level analyses pay close attention to breast fed status as failing to do this systematically is a potential source of noise or error in reports, whether these are presented as month by month statistics or aggregated across multiple months.

Another important difference between the breast fed and non-breastfed infants is the difference in patterns of growth faltering. The sharper decline among the breast fed cannot be explained by the measurement standard as the new WHO standards were used. The same phenomenon has been reported by Zhang (2009⁹³) in China, and Moursi (2008⁹⁴) in Madagascar, both of whom also analysed data in the 6 to 11 month age group from urban areas where bottle-feeding is a more

common practice.

One possible explanation, if a substantial portion of the dairy consumed as a substitute by the non-breastfed comes from infant formula, is that the fortification with micronutrients of breastmilk substitutes is contributing to the growth of these infants in ways that are not compensated for by the notably poor diets of their breastfed counterparts (ref Paper 1). This would be consistent with the IYCF guideline to feed breastfed the child fortified foods, although that recommendation precludes bottled milk. This certainly warrants further investigation.

Conclusions

The results of this study show that a global measure of complementary feeding practices – dietary diversity – is significantly associated with attained size at the end of infancy in a population characterized by mild to moderate endemic undernutrition. The findings that meal frequency (a proxy for quantity) did not improve the predictive association with growth, and that the individual food groups from which the indicator is derived, are not associated with growth, raise questions about how to interpret and use this indicator in relation to its three stated purposes of “assessment, targeting, and monitoring and evaluation” (WHO, 2008).

While it can be argued that DD and MF are only two of multiple dimensions of IYCF, these two have been identified as the key components of the IYCF summary measure (WHO, 2008), hence their performance vis-a-vis the key biological outcome of growth is crucial to the use and understanding of the indicators - individually and as a whole.

Dietary Diversity was never intended to be used for identifying individual children for interventions (WHO, 2008). The low correlations with growth that we found in this study substantiate the wisdom of that decision. From a programmatic standpoint, the DD indicator stands in sharp contrast to the breastfeeding indicators, which are directly useful for programmatic use because they refer to specific behaviors, which are directly related to health outcomes.

In theory, dietary diversity indicators could be used for screening and for assessing progress of interventions if they are reframed in relation to local feeding behaviors. There is nothing intrinsic to the concept that prevents operational specificity. In fact, the translation of general principles of good complementary feeding behavior to local conditions, which should be an essential aspect of behavior change communication planning, provides the data on which to base locally-appropriate, behavioral indicators of dietary diversity. With local adaptation DD can become a program tool, as well as a tool for population, without local adaptation to identify the specific food behaviors the CF indicator remains an abstract concept that attempts to summarize a complex set of behaviors.

Chapter 4

Applying ethnographic methods in formative research on complementary feeding in the Philippines yields essential data for program development and survey design

Abstract

The translation of biological knowledge to fit the realities of community conditions and behaviors is a critical public health challenge. We illustrate the application of specific ethnographic methods in a formative research study as a means of obtaining data and insights about caregivers' perceptions of complementary foods (CF) and the underlying beliefs and constructs that affect their understanding and interpretation of nutrition messages. The methods were applied in interviews with mothers (n=20) in an urban-poor Manila suburb, and the results were verified through focus group discussions (n=40). Among the important findings was that mothers were focused on the role of specific foods and timing of feeding as causes of illness, while the role of foods in promoting child growth and health was much less salient. Mothers' constructs differentiate between meals and snacks, and between nutritive liquids and semi-solid/solid foods in ways that could influence communication of messages as well as affect indicator construction. Even more important, the understanding of the unique position of breastmilk, and its transition from being a central to a supplementary component in mothers' constructs of their infants' diets, may be helpful in efforts to sustain breastfeeding throughout infancy. Adaptation of generic complementary feedings recommendations provide an important basis for designing interventions to improve infant and young child nutrition, but without adaptation to local socio-cultural and linguistic realities their potential is seriously compromised.

Introduction

The translation of biological knowledge into the design and implementation of programs that fit the realities of community conditions and household behaviors is a critical public health challenge. Among the most at risk and vulnerable groups for which such translation is essential are infants and young children who live in resource-constrained environments. The development and dissemination of the “Guiding Principles for Complementary Feeding” (for breastfed children, PAHO/WHO, 2003⁹⁵ and non-breastfed children, WHO, 2005⁹⁶) are landmarks in public health nutrition because they provide a firm, scientific foundation on which to base nutrition interventions directed to infants and young children. The types of interventions to which the guidelines apply include community-based programs, either stand-alone or integrated into health and/or social services; individual nutrition counseling in various contexts, and mass media campaigns. Of necessity, the guidelines are framed as generic recommendations, and, as is always the case with generic guidelines, they must be adapted to the context in which they are applied.

The Bamako Call to Action outlining a strategy for global implementation of health research (World Ministers Forum, 2008⁹⁷) stresses the importance of formative research to support “translation” from generic guidelines to locally-adapted recommendations and messages. The report draws attention to a variety of tools and manuals that are available to facilitate the development and implementation of interventions, including manuals for formative research (Dickin et al, 1997⁹⁸)

Formative research presents several challenges for programs, including issues of inadequate availability of personnel, time, and financial resources to conduct the studies. There is no single best

approach that is appropriate for all countries and situations. While methods and tools have been developed, their application to address specific needs and contexts requires exploring and combining different approaches. In this paper we describe a formative research study in which ethnographic methods were combined with a common formative research technique, focus group interviews, in a study conducted in a peri-urban area of Manila, Philippines. The multi-method approach permitted us to efficiently obtain a picture of caregivers' perceptions about foods that were currently used or potentially available to give as complementary foods, and the underlying beliefs, values and cultural constructs that affect how caregivers were likely to understand and interpret nutrition messages and nutrition counseling advice, including advice about nutritional aspects of the management of diarrhea.

Methods

The study site and the research participants

The formative research was conducted prior to initiating a large intervention study in Muntinlupa, Metro Manila. The project was aimed at improving nutritional status and diarrhea care practice in infants (Saniel et al, 1993⁹⁹) It was undertaken by the Research Institute for Tropical Medicine (RITM). Muntinlupa, which is located 25 km south of Manila, is a transportation hub, and all buses traveling from the south to Manila have terminals here. While many households were located in crowded, urban slums, the town also included poor fishing hamlets located along the shores of Laguna Bay. The households that participated in the intervention were selected on the basis of housing materials in order to ensure that they comprised the poorest households in the community. The average per capita income was <\$2 per day (using 1993 US \$: Philippine Peso conversion rates),

barely enough to meet basic needs for urban dwellers. Less than 5% of households owned the land their house was built on, and more than 1/3 were illegally occupying the land.

The formative research involved two samples of respondents: 40 mothers who were recruited to participate in focus group discussions (6-8 mothers per group) and 20 mothers who were interviewed individually with the ethnographic methods described below. Both samples were randomly selected from households in the intervention study. The age of the mothers was from 17 to 47, but the majority were in their twenties. Most of them had finished elementary school, had 2-3 children and almost all of them were housewives who did not work outside the home.

Ethical clearance for the formative research activities was obtained as part of the clearance for the large project from the RITM IRB and from WHO, who provided funding and technical support for the study.

Data collection

The RITM field staff who conducted the formative research all had some qualitative research experience prior to the study. They were given specific training on the data collection tools by the primary author of this paper (CA). The individual interviews were conducted, by appointment, at the mothers' homes. The focus group discussions (FGDs) were organized with the help of *barangay* (village) health workers and usually conducted at a multi-purpose village hall or at the village leader's home. Mothers were not compensated for their participation although, as is the custom in Filipino culture, a snack was prepared and consumed during the group discussions. With permission of respondents audio recordings were made of all individual interviews and FGDs.

The ethnographic tools

Cognitive mapping procedures, developed by ethnographers to facilitate obtaining systematic descriptions of people's perceptions (Weller and Romney 1988¹⁰⁰), were central tools for the study. Two ethnographic techniques were used in the individual interviews: (1) free listing and (2) pile sorting

Free listing

The purpose of the free listing technique is to generate a list of all the items or elements that belong in a particular social, behavioral or cultural domain. As anthropologist, Russell Bernard, wrote about this technique: "Free listing is a deceptively simple but powerful technique...you'd be surprised at how much you can learn from a humble set of free lists" (Bernard, 2006 p. 301-302¹⁰¹). We followed the procedure recommended by Bernard. It is an appropriate tool to obtain a list of items in the domain of foods for infants and young children.

Pile Sorting

The purpose of the pile sorting exercise was to understand how mothers organize their knowledge about foods and the meanings they attach to them. The pile sorting technique is a tool for examining meaning using a comparative process in which an individual is asked to sort a body of items (objects, ideas, persons) into groups (i.e. into "piles") that "belong together." (Bernard, 2006). The procedure followed the instructions outlined in Pelto and Pelto (1978¹⁰²). Each item was written on a separate card, and, as all the mothers were literate, we did not need to use pictures to indicate the items. The

cards were handed over to the respondent with the instruction to group the cards she felt “belonged” together. She was encouraged to re-group items and create additional piles as often as she felt was necessary. She was then asked for the reasons for each pile, and the responses were recorded, together with the content of the piles.

Focus group discussions

Four groups of 6 to 8 mothers were constituted and were led in discussions about their feeding practices. Armed with the list of foods generated by the free listing interviews, the FGD facilitator asked mothers a series of questions, including how they prepared and gave the different foods and drinks to their young children, their experiences in terms of whether their children liked them or not, pros and cons of individual items and the timing and frequency with which they were given.

Data analysis

The audio recordings of the individual interviews and the FDGs were transcribed. The transcriptions were then treated as the primary data for “text analysis” Following the procedures described by Bernard (2006) we used a combination of grounded theory and content analysis to identify and code themes, descriptions of beliefs and practices, concepts, etc. The free listing and pile sorting data were analyzed with Anthropac (Analytic Technologies¹⁰³). From the package of statistical techniques in Anthropac we used the multi-dimensional scaling (MDS) program to generate a visual representation of mothers’ views about foods and drinks.

Multi-dimensional scale analysis is a data-reduction technique that, similar to factor analysis,

allows one to “tease out underlying relations among a set of observations” (Bernard, 2006). However, unlike factor analysis, which requires metric data, MDS can use non-metric data, such as those obtained during a pile sorting exercise. A proximity matrix can be generated for each individual who conducts a pile sort exercise. This may be thought of as “a mental map,” a representation of the way he or she organizes ideas or knowledge about the particular domain represented by the items in a particular domain. An aggregate proximity matrix reflects the consensus or shared conceptualization of all the individuals who participated in the exercise. Items that are frequently grouped together have higher values in the aggregate proximity matrix.

By convention, the aggregate proximities are visually represented on an MDS graph by enclosed lines – solid lines represent more frequently grouped items, broken lines represent weaker associations (less frequently grouped items). It is important to remember in interpreting MDS graphs that they are two-dimensional representation of a multi-dimensional scale. Thus, items that appear visually separate on a two-dimensional figure may be enclosed together in a solid or dotted line. This is not arbitrary but reflects the values in the proximity matrix. In other words, they are more proximate on a dimension that cannot be visually presented in two dimensions. The visual representation makes it easier to relate the item clusters with the reasons mothers gave for grouping them together. With Anthropac the data from the pile sorting exercise can be analyzed into an aggregate proximity matrix to produce an MDS map, a visual representation that places items that are grouped together closer together in a two dimensional graph.

Results

Results of the free listing exercise

A total of 28 items, plus breastmilk, vitamins and ORS were listed by the 20 mothers who participated in the free listing exercise. Some mothers mentioned all 28 items in response to our initial requests for the lists. Others had to be prompted with the question, “anything else?” before they generated the full lists. Nearly all the woman ultimately named all the items, which are shown in Table 13. A notable feature of this list is that it included items that mothers thought were not good for infants, but were nonetheless, elicited in the exercise.

Table 13. Foods and Drinks for Infants from Free Listing

<i>Pagkain</i> (Foods)	<i>Inumin</i> (drinks)	Other
<i>lugaw</i> (rice porridge)	<i>gatas sa bote</i> (bottled milk, formula)	<i>gatas ng ina</i> (mother's milk or breastmilk)
<i>kanin</i> (boiled rice)	<i>am</i> (rice water)	<i>bitamina</i> (vitamins)
<i>giniling na bigas</i> (ground uncooked rice)	<i>tsaa</i> (teas)	<i>Oresol</i> (Oral Rehydration Solution)
<i>kalabasa</i> (squash)	“juice” (juice*)	
<i>itlog</i> (egg)	<i>sabaw</i> (soup/ broth)	
<i>tinapay</i> (bread)	<i>tubig</i> (water)	
<i>isda</i> (fish)		
<i>chamorado</i> (chocolate flavored rice porridge)		
“noodle” (noodles*)	*mothers refer to juice and noodles using the English terms	
<i>saging</i> (banana)		
<i>latundan</i> (different banana variety good for diarrhea)		
<i>mangga</i> (mango)		
<i>mansanas</i> (apple)		
<i>malunggay</i> (horseradish leaves)		
<i>talbos ng kamote</i> (sweet potato leaves)		
<i>chichirya</i> (“snack/junk” foods)		
<i>patatas</i> (white potato)		
<i>camote</i> (sweet potato)		
<i>pritong pagkain</i> (fried foods)		

Results of the pile sorting: the MDS scaling of foods and drinks

The results of applying MDS scaling to the pile sort data, together with the information from the statements made by mothers during the process, revealed that mothers based their food groups for infants and young children (Fig. 3) on the following constructs: 1) items that go together in a meal (e.g. rice and fish); 2) items that can be given as a snack (noodles and “*chamorado*”); 3) fruits (including “*latundan*” which is used commonly when a child has diarrhea); 4) vegetables, which have two subgroups: (i) leafy greens (“*malunggay*” horseradish leaves and “*talbos ng camote*”, sweet potato leaf tops) and (ii) starchy vegetables (squash and potatoes); 5) foods that are perceived as not good for children, which include oily foods and “*chichirya*”, salty, puffy snacks, often corn-based; and 6) drinks (tea, *am* and ORS.)

Breastmilk was in a unique position right in the middle of the figure, between solids and liquids, close to bread and to the meal group (rice and fish). However, it was also in the same cluster as noodles and chocolate porridge, which are snack foods. This location may reflect the fact that 1) breastfeeding is usually not perceived as a meal (see discussion below) and 2) breastmilk is considered as both “*pagkain [ng sanggol]*” (food [of the infant]) and 2) “*inumin*” (drink). A common belief pertains to breastmilk coming out of the first breast offered as “*pagkain*” and that coming from the second breast as “*inumin*”, hence the advice to offer both breasts when feeding in order for the child to “complete” his feeding.

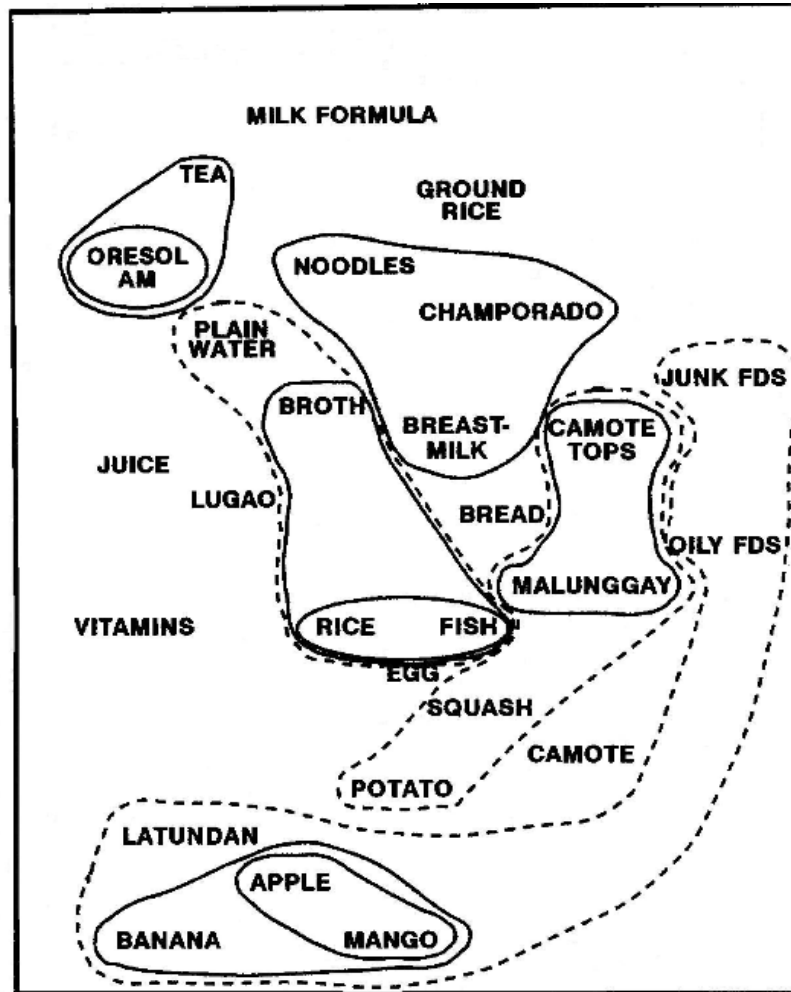


Figure 3. Multidimensional scale model of mothers' food groups

Several foods did not fall readily into a group shared with other items: bread, egg, infant formula, juices, rice gruel and ground rice did not fit into clusters. This finding is partly an artifact of the fact that there were considerable differences among the women on how they viewed these foods. The items were not necessarily left to “stand alone,” but because there was less consensus among the respondents about how to group them, they ended up with lower scores in the aggregate proximity matrix. Consequently, their position in the multidimensional space represented in the graph is less easy to interpret.

Beliefs , values and perceptions related to complementary feeding

The findings below concerning beliefs, values, and knowledge were derived from analysis of the text elicited in the course of asking women about their reasons for the pile sorting groupings. The transcripts from the FDGs helped support and confirm the results. In the analysis we identified the following main cultural features related to complementary feeding.

Definition of “food”

A primary linguistic distinction is made between food and liquid. In the national language (Pilipino, which is largely based on Tagalog) food is “*pagkain*” and refers to solid and semi-solid items. The verb “*kain*” (“to eat”) incorporates this concept. Liquids, even those of high nutrient density, are not considered “*pagkain*” (foods) and need to be referred to as “*inumin*”(more often literally translated as drinks). This distinction applies universally, including to infancy and early

childhood. Thus, babies and young children are given “food” and “drinks,” but there is no single concept that encompasses both.

What is a meal? What is a snack?

Meals were defined as a feeding event in which rice – was consumed, either as “*kanin*” (boiled rice) or, often in the case of infants and young children, as “*lugaw*” (rice porridge or rice gruel). Meals were designated by the time of day in which they are consumed: *almusal* or breakfast (from the Spanish *almuerzo*, which may refer to breakfast or brunch). *Almusal* was used with reference to an eating event that occurred anytime from early morning until about noon. After that the meal became *tanghalian* or lunch (from the root *tanghali*, which means noon), and as night falls became *hapunan* or dinner (derived from *dapithapon*, or *pagsapit ng hapon*, an expression for sunset).

Foods that were eaten at other times, between meals, were usually referred to as “*merienda*,” (derived from Spanish for snack). These were consumption events that could have included substantial portions of starches - including noodles, pasta, oatmeal, potatoes – but did qualify as a meal because they did not include boiled rice. Rice could be an ingredient in a dish and still be thought of as a snack if it was prepared with sweet or savory additions. Snack foods for young children prepared as a sweet or savory snack included rice cakes, or any sweetened form such as “*ginataan*” (sticky rice cooked in coconut milk with sugar) or “*chamorado*” (sticky rice gruel flavored with chocolate).

Breastfeeding is, by cultural expectation, not a meal. In the MDS it tended to be grouped with foods and drinks consumed outside of a meal, which by western convention are generally considered

as “snacks”.

The functions of foods

Mothers saw food as necessary primarily for survival (“*para mabuhay*”). Food was also important as a means of protecting children from illness (“*para hindi magkasakit*”). However, specific foods, as well as poor feeding practices, could also be a source of illness. Thus, the management of complementary feeding involved finding the delicate balance between feeding foods that children need for survival and avoiding foods and practices that will make them sick.

When a child became ill, particularly with diarrhea, treatment included changing the diet. A food that was thought to be particularly important to give during diarrhea was *am* (rice water). For a child with diarrhea, *am* consisted of water that was obtained from washing rice. A variant of “am” consisting of boiled ground rice was also given. The variety of banana known as *latundan* was another food that was thought to be good for a child with diarrhea.

The concept that food is important for growth or well-being was rarely mentioned spontaneously and typically only entered discussions after explicit prompting from the interviews. In other words, it had low salience for mothers. On the other hand, mothers did have a concept that can be translated into English as “nutritious,” although the literal translation is “substance-full.” In general fruits and vegetables were perceived as “*masustansiya*” (“nutritious” or “substance-full”). Mothers tried to give these foods to their children. They preferred to give “fleshy” fruits and vegetables, like squash or mangoes, to leafy and fibrous ones, which were seen as “*mahirap tunawin*” meaning difficult to digest.

Digestibility and foods that are not good for children

Digestibility was a key concept for mothers in Muntinlupa. They were concerned about the “digestibility” of foods because they were afraid their children would get “*impatso*,” a folk illness manifesting with abdominal pain and diarrhea or constipation (depending on the food involved) and believed to be caused by an individual’s inability to digest food properly (“*hindi natunawan*”). Mothers often did not give leafy vegetables to young children, and they mentioned the appearance of parts of leaves in their children’s stool as evidence of its indigestibility. The same reasoning extended to other fibrous fruits and vegetables, including pineapple and corn kernels.

Foods that are “oily,” or that were labeled as “junk” foods, were also thought to cause diarrhea and belonged to the larger category of foods that are not good for infants and young children. While snacks, as a general category, contained foods that were acceptable or even desirable for infants and children, snacks prepared with coconut milk were thought to be bad foods for young children because they are perceived to be “*mamantika*” (oily).

Fish were also included in the category of foods that were potentially harmful. A child who ate fish might get “*bulate*” (worms). In essence, foods were bad when they carried the risk of producing illness.

Timing of feeding

The concern about “digestibility” also influenced the timing of feeding. Mothers were afraid to

feed their children solids in the evening because the child might have digestion problems during the night and would therefore be “*maging perhuwisyo*” (“bothersome”). Mothers often did not feed an evening meal to young children in order to avoid this potential. On the other hand, early morning feeding of solids was also infrequent because “*baka hindi pa matunawan ang bata kapag masyadong maagang pakainin*” (child may not be ready to digest yet when fed too early). This situation would also cause “*perhuwisyo*” during the day.

Amount of food per feeding

Giving too much food in a feeding could lead to “*impatso*,” so mothers were careful about monitoring a child for cues that he or she had eaten enough and was “*sapat na*” (literally “enough already”). A child was thought to have had his fill (“*busog*”, meaning full) when he did not seem to be as interested in eating as he had been at the beginning of feeding. Mothers often said they would stop as soon as the child’s interest waned as a precaution against *impatso*. If a child has been recently ill, some mothers might try to coax him to eat more, but fear of “*impatso*” or of vomiting (“*pagsusuka*”) made mothers anxious not to give too much. This belief was particularly challenging for mothers who felt their child was “*payat*” (thin) because there was general agreement that mothers should try to feed more for this condition. According to respondents, leftovers might be eaten by the mother or put aside for the next feeding. The quantity of food prepared for the child depended on her perception of the child’s intake during recent feedings, as well as the availability of suitable food in the house.

Discussion

The primary motivation for undertaking the ethnographic research in Muntinlupa was to inform the development of the behavior change communication materials for a nutrition and diarrhea intervention project. It was based on the assumption that it is difficult for people to act on messages they do not understand or messages that are not framed in terms of the larger conceptual organization of cultural knowledge they use to guide their daily behaviors, and it is, therefore, essential to adapt biomedically grounded recommendations to the specific cultural environment. It was important to do this for the specific project, which had the goal of testing the potential of mother peer counselors as behavior change agents (Chung et al, 2008¹⁰⁴). Since the research in Muntinlupa was undertaken, the creation of guidelines on complementary feeding (1, 2) makes it even more imperative to find efficient means of translating generic guidelines to specific locations. In the following section we highlight some features of the findings that had implications for developing appropriate behavior change messages and approaches in Muntinlupa. Beyond their practical importance for the nutrition and diarrhea intervention program in Muntinlupa, these examples illustrate the types of translational challenges for program development and survey design that confront programs and investigators in every setting.

The concept of food

The finding that “food” and “drink” do not form a single entity for the mothers in Muntinlupa presents a challenge for communication of messages that are framed by nutritionists in terms of “food.” For the mothers “food” is one thing and “drink” another. If one wants to communicate about nutritive substances, it cannot be “glossed” (footnote 1) as “food,” as to do so causes confusion for

the Tagalog speaker about the “universe” of substances being referred to.

This concern is not merely an academic argument; it has practical public health implications. Consider, for example, the case of communications about diarrheal disease management. For many years child health programs around the world conveyed messages about the use of oral rehydration therapy (ORT) for the management of diarrheal diseases by simply translating the English word “diarrhea” into the local language. However, just as the Inuit peoples have a number of words for snow, in many cultures there are several words for diarrhea, each referring to a different type of this serious childhood illness, which, for years, was the number one killer of children around the world. By selecting one of these words for the messages in the translation from English (or French or Spanish), the public health authorities were, in effect, telling mothers that they should give ORT for only one type of diarrhea, the one that happened to be referenced by the term they had selected. For a number of years national monitoring surveys for diarrheal disease control programs returned disappointing results, showing low use of ORT in spite of massive communication campaign efforts. Ethnographic evaluations revealed that typically mothers were complying with the recommendation, giving their children ORT whenever they had the relatively “kind” of diarrhea that the public health messages referred to (Nichter, 1991¹⁰⁵).

These results about the “food” and “drink” distinction also raise a caution about how to collect information about feeding frequency and the timing of feeding episodes. In order to derive a frequency of feeding measure one would have to begin with a question about the times when “foods” or “*pagkain*” were given to the child – “*ilang beses ninyo pinakain ang inyong anak kahapon?*” A literal translation – “How many times did you feed your child yesterday?” - would **not** include liquids

whereas the intention of the question, phrased in English could include liquids as well as solids. Therefore, it would then be necessary to ask a second question: “*ilang beses ninyo binigyan ng mga inumin, bukod sa tubig, ang inyong anak kahapon?*” (How many times did you give drinks, aside from water, to your child yesterday?). Still another question “*ilang beses ninyo pinasuso ang inyong anak kahapon?*” (How many times did you breastfeed your child yesterday?) is necessary to capture the frequency of breastfeeding, because breastmilk could be considered both “*pagkain*” and “*inumin*” in Tagalog.

In addition to the definitional issues about foods and liquids, local concepts about meals and snacks also have the potential to generate inaccurate communication as well as introducing a problem for the construction of indicators. The Guidelines on Complementary Feeding (1,2) contain advice on “meals” and “snacks.” The manual on Indicators for Assessing Infant and Young Child Feeding Practices (WHO, 2008¹⁰⁶) requires information to construct a measure of “Meal Frequency”. In Muntinlupa only a feeding event that includes boiled rice or rice gruel qualifies as a “meal.” Everything else is “a snack,” regardless of its food content. Asking questions about meals and snacks would distort the picture of actual feeding practices, particularly as “snacks” are generally regarded as less substantial than meals. Moreover, as some snacks are viewed in a negative light, but are still given to infants, there would be a tendency for women to forget or hesitate to report them. This example about how responses are influenced by nuances in the language, and affected by beliefs, highlights differences between the *emic* (insider’s, in this case the mothers) perspective and the *etic* (outsider’s, in this case, the nutritionist- researcher’s) perspective (Pelto and Pelto 1978).

The particular nuance of breastfeeding of being closer to a snack than to a meal, warrants further

examination. While mothers certainly recognize that milk is essential to infants before complementary foods are introduced, this value appears to change once the child begins to consume more and more of the family diet. An investigation of the role of breastmilk vis-a-vis food and nutritive drinks as a source of sustenance, and as a factor in illness prevention may help explain why mothers fail to sustain breastfeeding or, in the case of nonbreastfeeders, why mothers in this community shift to lower quality milk substitutes (Chapter 2) during this period.

Orientation to food as illness prevention rather than growth promotion.

A fundamental feature of the cultural model that the mothers in Muntinlupa used to organize their knowledge about foods and feeding was the relationship of foods and feeding practices to the prevention of illness. The role of food in promoting health was much less central, and the concept of foods as promoters of growth and development did not emerge spontaneously as a salient aspect of their cultural interpretations. If mothers' orientation to food is fundamentally related to disease and disease prevention, messages promoting the importance of nutrition need to be framed in relation to this orientation.

Mothers concerns about digestibility are closely allied to the disease prevention orientation. This presents some challenges for adapting the guideline to *“Increase the number of feedings, as the child grows older, ... with the appropriate number depending on the energy density of the food and the usual amount consumed during each feeding.”* Increasing the number of feeds per day without feeding in the morning or the evening would be difficult. Other findings that are relevant for adapting the recommendations include the fact that feeding energy dense foods and avoiding the problem of recommending foods that are defined as “oily” may also be challenging. A recommendation to give

animal source foods faces the problem that fish is the most widely available food but is regarded as problematic during this period of a child's life. Yet another challenge is addressing the issue that mothers are reluctant to give leafy green vegetables to their infants and young children because of their association with digestive difficulties.

Another feature of the organization of knowledge that emerges from the cognitive mapping exercise is the composition of food groups. The concept of food groups is probably universal in human societies because it is a manifestation of the human tendency to classify and categorize experience. However, the content of food groups is subject, at least to some extent, to cultural construction. Even within "nutritionists' culture" there are changes over time in how foods are classified into groups. Of particular relevance to infant feeding practices is the classification of eggs, which has moved from being counted as part of the meats, poultry and fish food group to being in a food group on its own in the Demographic and Health Surveys (WHO, 2010¹⁰⁷). The MDS scaling revealed the basic classification scheme of the Filipino mothers in Muntinlupa.

How important is cultural (cognitive) local adaptation?

The experiences with diarrheal disease management (described above) argue for careful attention to the matter of linguistic translation. Our discussion about the linguistic features of "foods" and "drinks" is similarly focused on specific features of translation. However, the issue goes beyond finding appropriate words (Launer & Habicht, 1989). It is difficult for people to act on messages they do not understand, messages that are not framed in terms of the larger conceptual organization of cultural knowledge they use to guide their daily behaviors. Unfortunately, strong evidence about the

importance of local (cultural) adaptation is not well-developed in nutrition, nor in most areas of public health, although most public health professionals, including nutritionists, would readily agree that communication of advice has to be culturally appropriate. Informally people who work on the front lines of health service delivery and health and nutrition communication readily describe personal experiences in which differences in language, concepts and culture between providers and clients/patients led to misunderstandings and undermined treatment objectives. The so-called grey literature of program evaluation also attests to the problems that arise when interventions are not adapted to local conditions and the benefits that accrue when they do.

One study that provides some evidence for the value of cultural adaptation of messages for child health is an investigation in Vietnam that was undertaken by two of the authors of this paper (GHP and CA) in collaboration with our Vietnamese colleagues (footnote2) for the explicit purpose of testing local adaptation of information about acute respiratory infection (WHO, 1999¹⁰⁸). The purpose of the study was to assess differences in mothers' recall of messages, delivered by trained health workers, using either *emic* (local cultural) terms for danger signs of pneumonia or direct translation into Vietnamese of the generic WHO messages. First a focused ethnographic study of acute respiratory infections was conducted in a peri-urban area of Hanoi using the WHO protocol that includes a module to identify local (*emic*) terms for different types of respiratory symptoms. Then two public clinics in demographically similar neighborhoods were randomized to give either *emic* messages or generic messages to mothers who brought children with signs of ARI for care. At follow-up home visits a week later only 12% of mothers in the literal translation group recalled the danger signs for pneumonia. In contrast among mothers who received messages using *emic* terms the recall rate more than doubled to 27%. An *emic* term is more than a better translation, it reflects a different

disease concept and is embedded in a cultural explanatory model of illness, with its own explanations of etiology and treatment. By using this concept, the doctors in the clinic initiated a different type of communication with the mothers, which helped more of them to remember the important information that was being transmitted in the clinical consultation.

Conclusions

Maternal perceptions and understanding of foods and feeding during the period of complementary feeding are important for two reasons, in particular: (1) They affect how mothers understand and interpret communication activities and messages, including messages delivered in the context of nutrition intervention programs, in individual nutrition counseling and in mass media campaigns. (2) They influence how mother's respond to questions in surveys, as well as in clinical interviews, and thus affect the validity of data that are collected for the purpose of monitoring infant feeding practices, including infant and young child complementary feeding (IYCF) indicators.

Families everywhere have clear concepts that affect their infant feeding practices and guide them in making decisions about what, when and how to feed their children in relation to the social and economic constraints they face and the environments in which they live. Their cognitive models will have areas of congruence and areas of divergence from the constructs of nutritional science. Generic recommendations for complementary feeding provide an important base for designing interventions to improve infant and young child nutrition, but without adaptation to local socio-cultural and linguistic realities their potential is seriously compromised. Several prerequisites are necessary to support adaptation of generic guidelines: (1) manuals for local adaptation studies that are feasible

within the constraints faced by programs, and that include guidance on the analysis and interpretation of data; (2) trained personnel and technical support for adaptation activities; (3) logistic support for these activities, and (4) a policy environment that provides the resources, the motivation to undertake this essential work and the openness to apply findings to programs.

The ethnographic techniques that were used in this formative research for an infant feeding intervention project revealed some of the important, specific areas of conceptual congruence and areas of conceptual differences between the nutritional/public health professionals who were charged with the responsibility of developing an infant feeding intervention and the mothers to whom the intervention was directed. The techniques produced a rich body of data on perceptions about specific foods as well as the larger structure of beliefs within which these perceptions are embedded. It also yielded information on practices (eg. frequency of feeding) and the cultural rationale underlying them. The ethnographic techniques were easy for research assistants to administer and yielded a wealth of information in a short time. In this population there was no problem with putting written words on the cards because all of the women, though extremely poor and living in a difficult environment, were literate. In populations where most of the respondents are not literate it would be necessary to put visual representations of the foods on the cards, which would require somewhat more time for materials development. However, the techniques have been used successfully in many different cultural settings to obtain data on perceptions on a variety of different topics (Meza, 2008¹⁰⁹, Beltran 2008¹¹⁰, Le 2007¹¹¹).

The use of the statistical software (Anthropac) and the text analysis relied on the skills of the primary investigator (CA). Anthropac is no more difficult to learn and use than Epi-Info, which is

now widely used for basic data analysis, including analysis of results from formative research or baseline surveys. To apply Anthropac in other settings would, of course, require the development of a guideline and training to facilitate these analysis, but these are feasible with a relatively small investment.

This paper has focused exclusively on the aspect of formative research related to cultural beliefs and perceptions. Clearly this is only part of the story for behavior change interventions. Recommendations have to be actionable, as well as understandable (Pelto 2008¹¹²). Formative research to obtain data for developing and testing the actionability of recommendations requires other types of techniques and approaches, including procedures for “trials of improved practices” (TIPS) (Dickin et al, 1997) as well as careful analysis of food availability, economic resources for food acquisition, and attention to childcare organization, including maternal time availability.

Footnotes

Footnote 1

The word gloss is used as defined by the New American Oxford Dictionary: an explanation, interpretation, or paraphrase : the chapter acts as a helpful **gloss on** Pynchon's general method.

Footnote 2

The Vietnam study was conducted in Hanoi under the able leadership of Dr. Hoang Thi Hiep, then Secretary of the Vietnam National ARI Programme

Chapter 5

Summary and Conclusions

Guidelines for complementary feeding (CF) and a set of CF indicators to track progress in adherence to them and achievement of policy and program goals have been developed by WHO/UNICEF and their partners (WHO, 2008¹¹³). A primary objective of this dissertation was to determine how two of the main CF indicators – Diet Diversity (DD) and Meal Frequency (MF) – related empirically to the diet and nutritional status of infants in a poor peri-urban community in the Philippines. Another objective was to examine the socio-cultural context of infant feeding in the same community to explore the implications of these contextual factors for local adaptation of the indicators and their interpretation with respect to programmatic and policy decisions.

The thesis used a data set from Muntinlupa, a poor, periurban community of metro Manila. That data set had been collected for other purposes but was sufficiently rich in both quantity and quality that it could be used to carry out an in-depth analysis of complementary feeding practices and related behaviors from socio-cultural, dietary and biological perspectives. This data set was also used for a WHO/UNICEF project to develop the indicators and thus contributed data and analyses to that international effort.

DD as a measure of diet quality using MMDA

The first part of this dissertation aimed to establish the biological basis for the use of DD by examining its relationship as an indicator of dietary quality with a measure for nutrient adequacy

(mean micronutrient adequacy or MMDA) as the standard, during the complementary feeding period. I addressed the research question “How well can diet diversity indicators predict dietary quality for Filipino infants 6 to 11 months old from a periurban poor municipality?”

Three conclusions are drawn from this portion of the dissertation:

1) The DD score relates to the MMDA, in general. However, even the highest DD scores do not correspond to adequate MMDA, and those below 3 for the breastfed and 4 for the non-breast fed are clearly inadequate. These cut-offs correspond to those currently in use for the DHS, but should not be interpreted as indicating adequate nutrient intake for those above the cut-offs.

2) The DD scores should not be used where fortification and supplementation is wide spread in the population because the relationship between DD and MMDA is attenuated where there is substantial fortified product intake. The findings that fortified foods attenuate the relationship between DD and MMDA is important because the feeding guidelines (WHO/PAHO 2003¹¹⁴) include a recommendation to give children fortified foods. The DD scores are not useful for infants and young children who are consuming fortified dairy and cereal foods, as recommended by WHO, because these are the major sources of energy for all the DD levels, including the lowest. Therefore it is not appropriate to use the diversity score as a marker of micronutrient intake without flagging fortified foods including ready-to-use-fortified foods.

Flagging fortified foods does not overcome the inappropriateness of using the DD when micronutrients supplementation occurs through pills, sprinkles or foodlets, as one would see no impact on diet diversity despite substantial improvements in micronutrient adequacy.

Breastmilk as a food group/category

For non-fortified populations, adding breast milk as a food group or category would improve interpretation. There would be one and the same cut-off for both breastfed and non-breastfed children. It will also prevent the false and counterintuitive perception that breastfed children are worse-off (because they will always have a lower score relative to the nonbreastfed) , with a potentially negative effect on the promotion of breast-feeding. This mistake will become increasingly common as the recommendation is forgotten that the DD scores must be interpreted differently for breastfed and non-breastfed children.

Therefore we recommend that the breast milk be coded as a food category.

DD, but not MF nor individual food groups, is associated with growth

The second part of the dissertation shows that dietary diversity is significantly associated with growth, measured using the residual of a regression model predicting attained size at the end of infancy. This statistical approach excludes influences mediated through attained growth at 6 months.

Another key findings from this section is that meal frequency (MF)(a proxy for quantity) did not improve the predictive association with growth. This finding needs to be replicated in other populations to see whether this measure should be omitted.

The third finding from this section is that the individual food groups from which the indicator is derived are not associated with growth. This indicates that there are no sentinel food groups, which might substitute or complement DD in assessing the quality of the diet.

Mothers' constructs of foods and drinks may affect indicator construction and communication of CF messages

The third phase of the dissertation provided the opportunity to look into possible links between the indicators and mothers' constructs of foods and drinks. Ethnographic techniques were used to investigate the conceptual food categories of the mothers of the infants in this study. The techniques produced a rich body of data on perceptions about specific foods as well as the larger structure of beliefs within which these perceptions are embedded. It also yielded information on practices (eg. frequency of feeding) and the cultural rationale underlying them.

The finding that “food” does not include “drink” for the mothers in Muntinlupa presents a challenge for communication of messages that are framed by nutritionists in terms of “food” . This also raises a caution about how to collect information regarding feeding frequency and the timing of feeding episodes.

The Guidelines on Complementary Feeding (PAHO/WHO 2003 & 2005¹¹⁵) contain advice on “meals” and “snacks.” The manual on Indicators for Assessing Infant and Young Child Feeding Practices (WHO, 2008) requires information to construct a measure of “Meal Frequency”. The

definitional issues raised in this paper about foods and drinks (liquids), as well as local concepts about meals and snacks, have the potential to generate inaccurate communication in addition to introducing a problem for the construction of these indicators.

This part of the dissertation focused exclusively on the aspect of formative research related to cultural beliefs and perceptions. Clearly this is only part of the story for behavior change interventions. Recommendations have to be actionable, as well as understandable (Pelto 2008¹¹⁶). Formative research to obtain data for developing and testing the actionability of recommendations requires other types of techniques and approaches, including procedures for “trials of improved practices” (TIPS⁶) as well as careful analysis of food availability, economic resources for food acquisition, and attention to childcare organization, including maternal time availability.

There is considerable evidence to suggest that interventions to improve complementary feeding practices have to be locally appropriate (Hotz & Gibson 2005¹¹⁷, Penny et al, 2005¹¹⁸). For the purposes of providing insights into the nature of the complementary feeding problems in peri-urban Manila, and what might be done to address them, the CF summary indicator contributes little to identifying what needs to be done. National policy already advocates a diverse diet as it is everywhere where the universal nutritional advice is to “eat a balanced diet.” The DD does nothing to indicate what the content a TIPS should be.

⁶Trials of Improved Practices (TIPs) involves a series of visits to selected homes to test new behaviors to improve child nutrition. The process was developed by K. Dickin and M. Griffiths for the Manoff Group.

The need for formative research

Families everywhere have clear concepts that affect their infant feeding practices and guide them in making decisions about what, when and how to feed their children in relation to the social and economic constraints they face and the environments in which they live. Their cognitive models will have areas of congruence and of divergence from the constructs of nutritional science. Generic recommendations for complementary feeding provide an important base for designing interventions to improve infant and young child nutrition, but without adaptation to local socio-cultural and linguistic realities their potential is seriously compromised.

The concerns raised about the CF indicators do not apply to the breastfeeding indicators, which serve a vital function for public health. There is an essential difference between the breast feeding indicators and the complementary feeding indicators, which makes the former useful for many purposes, including policy and program planning and evaluation, as well as cross-national comparison – namely that the breast fed indicators refer to specific behaviors, which are directly related to health outcomes, whereas the CF indicator is an abstract concept that attempts to summarize a complex set of behaviors. The principles of good breastfeeding practices transcend local conditions and can therefore be assessed with a universal tool.

While the principles of good complementary feeding are universal, the application of those principles will always be embedded in local diets and local conditions, and assessments of complementary feeding practices must therefore be conducted in relation to those conditions.

In summary, of the two complementary feeding (CF) indicators investigated in this dissertation the dietary diversity score (DD) was associated with biological measures of nutrient adequacy and growth, however it has limitations for interpretation where 1) infants' diets are relatively restricted in quantity and quality, and 2) fortified products are substantially consumed. (Chapters 2 & 3)

These findings indicate that local formative research is necessary:

1. to ensure that mothers' replies to surveys correspond to the information being sought by being sure that mothers understand what is being asked (Chapter 4)
2. to be sure the indicator is interpreted properly in its operational (Chapter 2 – fortification & breastmilk as a food group) and cultural (Chapter 4) contexts.

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Chapter 1

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