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Developing and Validating Simple Indicators of Dietary Quality of Infants and Young Children in Developing Countries: Additional Analysis of 10 Data Sets

September 2007

Working Group on Infant and Young Child Feeding Indicators

FANTA
FHI 360
1825 Connecticut Ave., NW
Washington, DC 20009-5721
Tel: 202-884-8000   Fax: 202-884-8432
fantamail@fhi360.org   www.fantaproject.org

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THE SCIENCE OF IMPROVING LIVES

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This publication was made possible through the support provided to the Food and Nutrition Technical Assistance Project by the Office of Health, Infectious Diseases and Nutrition of the Bureau for Global Health at the U.S. Agency for International Development (USAID), under terms of Cooperative Agreement No. HRN-A-00-98-00046-00 awarded to FHI 360. The opinions expressed herein are those of the authors and do not necessarily reflect the views of the USAID.

Published 2007

Recommended citation:

Working Group on Infant and Young Child Feeding Indicators. *Developing and Validating Simple Indicators of Dietary Quality of Infants and Young Children in Developing Countries: Additional analysis of 10 data sets.* Report submitted to the Food and Nutrition Technical Assistance Project) $ 1 7 $ /FHI 360, September 2007.

Copies of the publication can be obtained from:

Food and Nutrition Technical Assistance Project) $ 1 7 $
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Washington, D.C. 20009-5721
Tel: 202-884-8000
Fax: 202-884-8432
Email: fantamail@fhi360.org
Website: www.fantaproject.org

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ACKNOWLEDGMENTS

This report was prepared as part of a project that aims to develop indicators for assessing infant and young child feeding practices, undertaken as a joint effort by the Department of Child and Adolescent Health and Development of the World Health Organization (WHO/CAH), the Food Consumption and Nutrition Division of the International Food Policy Research Institute (IFPRI), the Program in International and Community Nutrition at the University of California, Davis (UC-Davis), the Food and Nutrition Technical Assistance (FANTA) Project of FHI 360, and the United States Agency for International Development (USAID).

The report was prepared by Kathryn G. Dewey, Mary Arimond, and Marie T. Ruel on behalf of the Working Group on Infant and Young Child Feeding Indicators. Working Group members include the following individuals (usually the principal investigators) who conducted analyses of previously collected data for ten study sites using a standard protocol (country of data set in parentheses):

- Cecilia C. Santos-Acuin, Institute of Clinical Epidemiology, National Institutes of Health, University of the Philippines, Manila (Philippines);
- Nita Bhandari, Society for Applied Studies, New Delhi (India);
- Hilary Creed de Kanashiro, Instituto de Investigación Nutricional, Lima (Trujillo, Peru);
- Roberta Cohen and Kathryn Dewey, UC-Davis (Bangladesh; Ghana; Honduras; Huascar, Peru);
- Christine Hotz, HarvestPlus (Malawi);
- Mourad Moursi, Institute of Research for Development, Montpellier (Madagascar);
- Helena Pachon, International Center for Tropical Agriculture, Cali (Brazil).

Other Working Group members include: Marie T. Ruel and Mary Arimond of IFPRI, who provided technical advice throughout the process and conducted additional data analysis; André Briend, Bernadette Daelmans, and Jose Martines of WHO/CAH, who provided technical advice and oversight to several of the analyses; Anne Swindale of the FANTA Project and Eunyong Chung of USAID, who contributed through workshop participation, discussions, and document reviews. The report was reviewed and endorsed by the principal investigators and the members of the project steering group at WHO/CAH, IFPRI, and the FANTA Project.

Four country analysis (Bangladesh, Ghana, Honduras, and Huascar, Peru): We gratefully acknowledge the other investigators involved in the infant dietary intake studies upon which these analyses were based: *Bangladesh*: J. E. Kimmons, E. Haque, J. Chakraborty, S. J. M. Osendarp, and K. H. Brown; *Ghana*: A. Lartey, A. Manu, J. Peerson, and K. H. Brown; *Honduras*: L. Landa Rivera; and *Peru*: H. Creed de Kanashiro, K. H. Brown, G. Lopez de Romana, T. Lopez, and R. E. Black.

Brazil: We thank the other original investigators in the Brazil study (C. Lutter, C. Victora, and C. Araujo). We also acknowledge Y. Shang for assisting with the implementation of the early steps of the protocol, C. Araujo for helping during the food coding, C. Lutter for providing financial support for improvements to the *Pro*PAN food composition table that benefited the current analyses, and M. Arimond for technical support.

India: A number of researchers collaborated in analyzing and reporting results for India. Researchers were V. Suri, Research Associate; B. Dube, Research Associate; N. Soin, Research Associate; S. Taneja, Research Coordinator; and N. Bhandari, Joint Director, all of the Society for Applied Studies, New Delhi, India. We also acknowledge the support provided by S. Mazumder and T. Rongsen during data analysis. We are thankful to K. Bhatia for the assistance provided in statistical analysis. We also thank M. Bagdwal and A. Verma for their secretarial assistance in compilation of the report.

Madagascar: We thank M. Arimond, M. T. Ruel, K. Dewey, and colleagues from the FANTA Project for a great collaboration. Special thanks to FANTA for their financial support for data entry. We also gratefully acknowledge the important contribution of L. Arnaud, C. Monvois, and O. Bruyeron from Research and Technological Exchange Group/Nutrimad and S. Trèche and F. Delpeuch from Institute of Research for Development.

Malawi: R. Gibson is acknowledged for her supervision of the data collection and analysis of this project.

Trujillo, Peru: We should like to express our thanks to M. Marin, for conducting the data analysis; M. R. Liria, for assistance with the implementation of the protocol; L. Ganoza, for adapting the IIN Peruvian food composition table to the requirements of the protocol; and K. Escajadillo, for secretarial assistance in compiling the report.

Philippines: We gratefully acknowledge D. Marcelo for her assistance in the data management and statistical processing for this report; P. Alday, M. Fulache, and N. Cerillo and the RITM IFIS Study Team for their assistance in data encoding, editing, and inputs to the final report; M. Arimond and K. Dewey for their very helpful comments and technical assistance; and the administrations of the RITM Department of Biostatistics and Epidemiology, De La Salle University AK Medical Research Center, and the University of the Philippines Department of Clinical Epidemiology for their support.

Finally, at IFPRI, we thank A. Subandoro and Wahid Quabili, who contributed to the analysis and constructed most of the summary tables, and also standardized collaborators’ reports for easier comparability, and J. Willis, who formatted and helped finalize numerous reports throughout this project.

ACRONYMS

AUC	Area under the receiver operating curve
FGI	Food group indicator
FGI7	Food group indicator summing 7 food groups, with a 1-g minimum for inclusion
FGI7R	Food group indicator summing 7 food groups, with a 10-g minimum for inclusion
FGI8	Food group indicator summing 8 food groups, with a 1-g minimum for inclusion
FGI8R	Food group indicator summing 8 food groups, with a 10-g minimum for inclusion
MMDA	Mean micronutrient density adequacy
MMDA-no iron	Mean micronutrient density adequacy excluding iron
PAHO	Pan American Health Organization
ROC	Receiver operating curve; also receiver operating characteristics
WHO	World Health Organization

1. INTRODUCTION

The lack of simple indicators of appropriate feeding practices has hampered progress in measuring and improving infant and young child feeding in developing countries. In response to these concerns, the World Health Organization (WHO) and the Pan American Health Organization (PAHO) set in place a process in 2002 to review and develop indicators of complementary feeding practices. The process was timely because the "Guiding Principles for Complementary Feeding of the Breastfed Child," which were being developed at the time, provided a useful framework for addressing the multidimensionality of complementary feeding practices (PAHO/WHO 2003). These Guiding Principles provide guidance and scientific rationale for 10 different aspects of optimal complementary feeding practices. Since they were published, a similar effort to develop guidance and rationale for feeding non-breastfed children 6-24 months of age was undertaken, which resulted in a technical document (Dewey, Cohen, and Rollins 2004) and a parallel set of Guiding Principles (WHO 2005).

Simple yet valid and reliable population-level indicators of infant and young child feeding practices are needed globally for the following purposes: (1) *assessment*: to make national and subnational comparisons and to describe trends over time; (2) *targeting*: to identify populations at risk, target interventions, and make policy decisions about resource allocation; and (3) *monitoring and evaluation*: to monitor progress in achieving goals and to evaluate the impact of interventions.

The process required to develop and validate global indicators of feeding practices involves a series of activities including analysis of existing data sets, field-testing of selected indicators, and technical meetings and workshops to promote interinstitutional dialogue and to reach consensus on best indicators. The research described in this report is based on analysis of existing data sets. The overall goal of the research was to contribute to a process of developing and validating indicators of diet "quality" and "quantity" for children 6-23 months. These indicators are intended to help measure progress with regard to 2 of the 10 Guiding Principles described above, specifically those pertaining to "Nutrient content of foods" and "Amount of food needed" (Box 1). For reference, Box 1 also includes the Guiding Principle that describes appropriate frequency of feeding.

Beginning in 2004, members of the Working Group on Infant and Young Child Feeding Indicators (hereafter "Working Group") completed a series of activities aimed toward definition and validation of such indicators. The two main questions addressed were the following:

1) How well can dietary diversity (sum of foods or food groups consumed over a reference period) or sentinel food group (selected nutrient-dense food groups) indicators predict dietary quality[1] for infants and young children in different populations with varying dietary patterns?

2) How well does the frequency of feeding (excluding breast milk) predict energy intake – either energy from foods alone or total energy intake – in different populations with varying dietary patterns?

[1] Dietary quality is defined in this report as "adequate micronutrient density of foods and liquids other than breast milk."

Box 1 Three Guiding Principles for Feeding Breastfed and Non-breastfed Children 6-23 months[a]

Nutrient content of foods

Breastfed children: Feed a variety of foods to ensure that nutrient needs are met. Meat, poultry, fish, or eggs should be eaten daily, or as often as possible. Vegetarian diets cannot meet nutrient needs at this age unless nutrient supplements or fortified products are used. Vitamin A-rich fruits and vegetables should be eaten daily. Provide diets with adequate fat content. Avoid giving drinks with low nutrient value, such as tea, coffee, and sugary drinks such as soda. Limit the amount of juice offered so as to avoid displacing more nutrient-rich foods.

Non-breastfed children: In addition to the above, non-breastfed children need ~200 – 500 mL/d of milk or yogurt, with the amount depending on intake of other animal-source foods. If animal source foods are not eaten in adequate amounts, both grains and legumes should be consumed daily. If dairy products are not consumed in adequate amounts, other foods that contain relatively large amounts of calcium can help fill the gap. The daily diet should include vitamin-A rich foods, vitamin C-rich foods, and foods rich in B vitamins including riboflavin, B6, and folate.

Amount of food needed

Breastfed children: Start at 6 months of age with small amounts of food and increase the quantity as the child gets older, while maintaining frequent breastfeeding. The energy needs from complementary foods for infants with average breast milk intake in developing countries are approximately 200 kcal per day at 6-8 months of age, 300 kcal per day at 9-11 months of age, and 550 kcal per day at 12-23 months of age. In industrialized countries these estimates differ somewhat (130, 310, and 580 kcal/d at 6-8, 9-11, and 12-23 months, respectively) because of differences in average breast milk intake.

Non-breastfed children: Ensure that energy needs are met. These needs are approximately 600 kcal per day at 6-8 months of age, 700 kcal per day at 9-11 months of age, and 900 kcal per day at 12-23 months of age.

Meal frequency and energy density

Breastfed children: Increase the number of times that the child is fed complementary foods as he/she gets older. For the average healthy breastfed infant, meals of complementary foods should be provided 2-3 times per day at 6-8 months of age and 3-4 times per day at 9-11 and 12-23 months of age.

Non-breastfed children: For the average healthy infant/child, meals should be provided 4-5 times per day.

Both breastfed and non-breastfed children: The appropriate number of feedings depends on the energy density of the local foods and the usual amounts consumed at each feeding. If energy density or amount of food per meal is low, or the child is no longer breastfed, more frequent meals may be required. In addition to meals, offer nutritious snacks (such as a piece of fruit or bread or chapatti with nut paste) 1-2 times per day, as desired. Snacks are defined as foods eaten between meals – usually self-fed, convenient and easy to prepare.

[a] Adapted from PAHO/WHO 2003 and WHO 2005.

These two potential indicators, dietary diversity and frequency of feeding, were chosen based on a conceptual framework that had previously been developed for identifying useful indicators of complementary feeding practices (Ruel, Brown, and Caulfield 2003). The objective of the research was to contribute to the development of indicators for use at the population level. Simple one-day indicators of diet diversity or feeding frequency cannot be used to characterize the adequacy of diets on an individual level. Further, the larger aim was to develop indicators for general population-level assessments and comparisons, between geographic areas and across time. We note, however, that the data sets used in this analysis were generally not appropriate for evaluating the responsiveness of the indicators as diets change over time. Finally, we note that summary indicators such as the ones discussed here can, by their nature, obscure specific diet quality problems, such as low intakes of one or two key micronutrients. Summary indicators should be viewed as complements to other more specific indicators, which should be used to track micronutrient deficiencies known to be of public health importance in any given context.

The first phase of this research involved development of a preliminary data analysis protocol, which was applied to four data sets (for results, see Dewey et al. 2005). Next, additional data sets and a broader group of collaborators were identified; the new data sets represented wider age ranges, more geographical areas, and more variety in feeding patterns (e.g., non-breastfed infants and young children). After meeting with Working Group members in October 2004, the analysis protocol was revised (Arimond et al. 2005) and was applied to six additional data sets. This work was summarized in a recent report submitted to the FANTA project (Working Group on Infant and Young Child Feeding Indicators, August, 2006). Results of analysis of data from the 10 sites (nine countries) were also discussed at WHO in October, 2006. Participants at the meeting affirmed the technical quality of the previous work, but raised additional questions and requested additional analysis of the available data sets. In particular, the Working Group concluded that, based on analysis to date, the derived indicators were better suited to flag *poor* dietary quality than *adequate* dietary quality. In the October 2006 meeting, several extensions to the analysis that might lead to indicators of *adequate* dietary quality were suggested.

In addition, the discussions led to questions regarding the relationship between milk (or dairy product) feeds and energy intake from milk products for non-breastfed children. Specifically, the group decided to recommend that the frequency of feeding indicator (solids/semi-solids) for non-breastfed children should be the same as for breastfed children, but that that indicator should not be used in isolation. Instead it should be interpreted in light of the adequacy of intake of the breast milk substitute. As a first step toward evaluating this, it was suggested that the relationship between milk feeds (both “yes/no” and number of feeds of milk or infant formula) and total energy intake from milk feeds be examined.

The current report aims to answer the above questions. The three specific objectives are to examine:

1) The relationship of food group diversity to adequate dietary quality, when the index of dietary quality excludes the adequacy of iron intake from the calculation. The Working Group recognized that iron was limiting in nearly all diets, and that iron needs are very difficult to meet without iron-fortified products.

2) The potential for combinations of “sentinel” food groups (e.g., consumption of an animal source food plus a fruit or vegetable) to be used as indicators of adequate dietary quality.

3) For non-breastfed children, the relationship between the number of milk (or dairy product) feeds and the total energy intake of milk/dairy products during the day.

2. METHODS

For this report, the following three additional analyses of the 10 available data sets were undertaken:

1) We constructed a new summary indicator of dietary quality, similar to the previous "Mean Micronutrient Density Adequacy" (MMDA) indicator, but excluding iron (hereafter called "MMDA-no iron"). As in the previous report, we examined the relationship between two simple indicators of food group diversity (a 7-group indicator (FGI7) and an 8-group indicator (FGI8)) and an MMDA-no iron cutoff of 75%, the operational definition of "adequate dietary quality" (at population-level). In other words, the purpose was to characterize how well FGI7 and FGI8 predict MMDA-no iron ≥ 75%.

2) We extended the previous analysis that explored the potential of individual nutrient-dense food groups to function as "sentinels" to distinguish inadequate diets from adequate diets. Using the same indicator of "adequate" (MMDA-no iron ≥ 75%), we created combinations of high-quality food groups, and tested the performance of these combinations as sentinel indicators:

   a. Any animal-source food[2] (flesh foods and/or dairy) *and* vitamin A-rich fruit/vegetable yesterday,

   b. Dairy products *and* vitamin A-rich fruit/vegetable yesterday,

   c. Any animal-source food *and any* fruit/vegetable yesterday,

   d. Dairy products *and any* fruit/vegetable yesterday.

3) We explored the relationship between the number of milk/dairy product feeds and the quantity consumed (kcal) by non-breastfed children. We related this quantity to an "adequate" amount, defined as the estimated kcal from breast milk received by a child fed an age-group specific "average" amount of breast milk.

Data for the above analyses were available from the same 10 studies described in the previous report: 3 in Africa, 3 in Asia, and 4 in Latin America. Table 1 provides dates and sample sizes for the studies. Most of the study sites were in urban or peri-urban settings (Ghana, Madagascar, the Philippines, Brazil, Honduras, and two sites in Peru), while the remaining 3 (Malawi, Bangladesh, and India) were in rural areas. In four sites – Ghana, Malawi, India, and one of the Peruvian sites (Trujillo) – the original data collection occurred in the context of intervention studies that included dietary improvement as an objective. Therefore both dietary diversity and diet quality (micronutrient density) could have been different from the typical patterns in those settings. Details of the methods and results for each study are presented in separate reports (Dewey et al. 2005; Acuin 2006; Creed-Kanashiro et al. 2006; Hotz 2006; Moursi 2006; Pachon and Frongillo 2006; Suri et al. 2006). The procedures used for the comparative analysis of all 10 data sets are described in the previous report (Working Group on Infant and Young Child Feeding Indicators, August, 2006).

[2] Note that for the purposes of these analyses, breast milk is not included.

As in the previous analyses, the dietary quality of the foods consumed was defined based on the density (amount per 100 kcal of food) of several key micronutrients (Dewey and Brown 2003). In these new analyses, however, the iron content of the diet was excluded from the calculation. For breastfed infants 6-11 mo, eight micronutrients were considered (vitamin A, thiamin, riboflavin, vitamin B6, folate, vitamin C, calcium, and zinc). For breastfed children 12-23 mo and for all non-breastfed children, vitamin B12 was also included, for a total of nine micronutrients. For each micronutrient, the individual nutrient density adequacy was calculated as the percentage of the desired nutrient density for that age and breastfeeding group (Arimond et al. 2005). The new overall dietary quality score, MMDA-no iron, was calculated as the mean of all eight or nine individual micronutrient density adequacies, with each capped at 100%. Thus, the maximum possible MMDA-no iron was 100%. For these analyses, the cutoff of ≥ 75% for MMDA-no iron was considered "adequate" micronutrient density.

Two different indicators of dietary diversity were used. One (FGI8) was based on a total of eight possible food groups: (1) grains, roots and tubers, (2) legumes and nuts, (3) dairy products, (4) flesh foods (meat, fish, poultry, and liver/organ meats), (5) eggs, (6) vitamin A-rich fruits and vegetables (> 130 RE of vitamin A per 100 g), (7) other fruits and vegetables, and (8) fats and oils. The other (FGI7) was similar but was based on seven possible food groups, excluding fats and oils. A food group was counted in the indicator if at least 1 g was consumed. Because FGI7 performed better in the previous analyses, results for that indicator are presented in the main report, and results for FGI8 are presented in the Appendix.

For all analyses in which an indicator was being evaluated, we calculated the area under the curve (AUC) for the receiver operating characteristics (ROC) relationship, and tested whether AUC was significantly different from the "null" value of 0.5. A value of 0.5 means that the indicator has no predictive value.

3. RESULTS

3.1 Descriptive statistics for MMDA-no iron

MMDA-no iron varied by age, region, and breastfeeding status (Table 2). Mean MMDA-no iron among breastfed children in the three African sites was 51-62% at 6-8 mo, 66-76% at 9-11 mo, and 70-72% at 12-23 mo. Mean values for breastfed children were higher in the Latin American sites (62-78% at 6-8 mo, 69-84% at 9-11 mo, and 80% at 12-23 mo). Mean MMDA-no iron was low in Bangladesh (39% at 6-8 mo; 54% at 9-11 mo) and among those who did not receive fortified products in the Philippines (47% at 6-8 mo; 53% at 9-11 mo), whereas the mean for breastfed children in India at 12-23 mo (72%) was similar to that for Africa. Mean MMDA-no iron was higher among non-breastfed children than among breastfed children. In the Philippines, mean MMDA-no iron was higher among infants who consumed fortified products than among those who did not. As expected, the means for MMDA-no iron were generally higher than those for MMDA in the previous report, due to the exclusion of iron from the calculation. The difference was +1-7 for breastfed children and +0-4 for non-breastfed children, except among infants 6-11 mo in Peru-Trujillo, for whom the difference was +14 in the breastfed group and +8-9 in the non-breastfed group.

Table 3 shows the percentage of each sample with MMDA-no iron < 50%, a cutoff that we are using to describe "poor" dietary quality. Among breastfed infants at 6-8 mo, this percentage was 26-56% in Africa, 57-67% in Asia (excluding infants in the Philippines who received fortified products), and 5-25% in Latin America. At 9-11 mo, the percentage of breastfed infants with MMDA-no iron < 50% was lower: 10-15% in Africa, 45% in Asia, and 3-13% in Latin America. By the second year of life, the percentage of breastfed children with MMDA-no iron < 50% was 4-13%. For non-breastfed children (excluding those who received fortified products), the percentage with MMDA-no iron < 50% was 0-23% at 6-8 mo, 2-13% at 9-11 mo, and 1-7% at 12-23 mo. As expected, most of these values were lower than those for MMDA<50% in the previous report (by up to 10 percentage points), with the differences being larger for infants 6-11 mo than for older children. This could be because iron needs are less likely to be met among the younger infants.

Table 4 shows the percentage of each sample with MMDA-no iron ≥ 75%, a cutoff indicating "better" dietary quality. At 6-8 mo, relatively few breastfed infants in Africa and Asia (excluding those in the Philippines who received fortified foods) had an MMDA-no iron ≥ 75% (6-30%), but in Latin America the percentage ranged from 31% to 72%. The situation for breastfed children improved by 9-11 mo (28-81% except in Bangladesh and the Philippines, where only 7-13% had MMDA-no iron ≥ 75%) and 12-23 mo (41-71%). For non-breastfed children, the percentage with MMDA-no iron ≥ 75% was low in the Philippines (8-14%, excluding those who received fortified products), intermediate in Madagascar (38-56%, depending on age), relatively high in India and Brazil (69-76% at 12-23 mo), and very high in Peru-Trujillo (92-98%). For nearly all subgroups, these values are higher than for MMDA ≥ 75% in the previous report, sometimes by a very large amount (e.g., among breastfed infants in Peru-Trujillo).

3.2 The relationship between food group diversity and mean MMDA-no iron

Food group diversity (FGI7) was positively associated with MMDA-no iron at all ages in all sites, in both breastfed and non-breastfed children (Table 5), except in the Philippines among three of the four subgroups who received fortified products (breastfed infants at 9-11 mo and non-breastfed infants at 6-8 and 9-11 mo). Among breastfed children, the significant correlation coefficients ranged from 0.38 to 0.77, with most of them > 0.5. The correlation coefficients were weaker among non-breastfed children, ranging from 0.25 to 0.56 (excluding those who received fortified products). In most cases, the correlations of FGI7 with MMDA-no iron were very similar to those with MMDA in the previous analyses (+/- 0.02), except in India, where the correlations with MMDA-no iron were considerably weaker than with MMDA (by -0.07-0.13), and in Peru-Trujillo, where the opposite was true (by +0.03-0.07 for infants 6-8 and 9-11 mo).

The correlations of MMDA-no iron with FGI8 are shown in Table A-1. These were generally weaker than those with FGI7, as was true in the previous analyses.

Figures 1-3 show mean MMDA-no iron at each level of food group diversity (FGI7) for breastfed children in each of the age groups. For breastfed children in the first year of life who did not consume fortified products, MMDA-no iron was generally < 55% when only one food group was consumed, increasing gradually with each additional food group until reaching an average of ~75-80% with four or more food groups. In the only study site (the Philippines) where large numbers of infants had formula and/or other foods specially fortified for infants, MMDA-no iron tended to be higher for these infants. In the second year of life, mean MMDA-no iron for breastfed children was ~60-70% when only two food groups were consumed, increasing to ~75-90% with four or more food groups. Among children 12-23 mo, very few consumed fortified products and these observations were dropped; the Philippines sample included infants 6-11 mo only. Excluding children consuming fortified products, the patterns of relationship between FGI7 and MMDA-no iron were more consistent across sites and more linear for breastfed children at 12-23 mo than at 6-8 or 9-11 mo.

Figures 4 and 5 show the relationship between FGI7 and MMDA-no iron for non-breastfed infants at 6-8 and 9-11 mo, separating those who consumed formula and/or specially fortified infant foods from those who did not. For those who had fortified products, the relationship between FGI7 and MMDA-no iron is essentially flat. For those who did not consume these products, the relationship is similar to those for breastfed infants, with MMDA-no iron increasing markedly as food group diversity increases. Figure 6 shows the same relationship for non-breastfed children 12-23 mo of age, with each curve showing a similar upward trend in MMDA-no iron with each additional food group. Figures A-1 through A-6 (in Appendix) show the relationships between FGI8 and MMDA-no iron.

Table 6 shows the area under the curve (AUC) values for the ROC curves describing the relationship between FGI7 and MMDA-no iron ≥ 75% in each age group and site. For children not receiving fortified products, all of the AUC values differed significantly from the null value, meaning that FGI7 had some power to distinguish between children above and below the 75% cutoff. Most of the AUC values were > 0.7 and highly significant. For infants receiving fortified products in the Philippines, the AUC values were significant for breastfed infants at 6-8 mo and for the combined age groups (6-11 mo) of both breastfed (AUC 0.77) and non-breastfed (AUC 0.57) infants.

The AUC values for the ROC curves of FGI8 with MMDA-no iron ≥ 75% are shown in Table A-2, and statistical comparisons of the AUC values for FGI7 and FGI8 are shown in Table A-3. FGI7 performed significantly better than FGI8 in Madagascar, Malawi, India, the Philippines, Brazil, Honduras, and Peru-Huascar. In the other sites, the difference in AUC values between FGI7 and FGI8 was not significant.

Tables 7 and 8 show comparisons of the AUC values for the ROC curves of FGI7 with MMDA-no iron ≥ 75% vs. the previous MMDA ≥ 75%. For breastfed children (Table 7), the AUC values were generally similar or higher for MMDA-no iron than for MMDA, except in India at 12-23 mo. For non-breastfed children (Table8), the AUC values for MMDA-no iron were somewhat better than those for MMDA in Brazil, but somewhat worse in India and among children in the Philippines who did not receive fortified products.

Sensitivity/specificity analyses were performed to explore the ability of food group diversity to accurately identify children with MMDA-no iron above vs. below 75%. Since we are primarily interested in population-level assessment and possibly geographic targeting, it is appropriate to look for some balance between sensitivity and specificity, and, similarly, to consider minimizing overall misclassification. In this situation (assessment of the percentage of children with "adequate" diets, rather than the percentage "at risk"), it is preferable to minimize the number of false positives, so as to avoid concluding that diets are adequate when they really are not. This means favoring specificity over sensitivity when the "outcome" is the percentage of children with MMDA-no iron ≥ 75.[3]

Tables 9 and 10 summarize the sensitivity/specificity results for discriminating children with a diet above or below the MMDA-no iron cutoff point of ≥ 75%, based on the FGI7 diversity indicator. [Similar tables for FGI8 are shown in the Appendix.] Using a cutoff of ≥ 4 food groups for breastfed infants at 6-11 mo (Table 9) who did not receive fortified products, sensitivity was 25-72%, specificity was 70-97%, the percentage of false positives was 3-17%, and the total percentage misclassified was 9-38%. The cutoff point of ≥ 3 gives consistently higher sensitivity (68-99%), but at the expense of lower specificities (40-86%), more false positives (13-38%), and higher total misclassification in five of the eight sites (14-42%). For breastfed children at 12-23 mo (Table 10), sensitivity at the ≥ 4 cutoff point was 34-88%, specificity was 56-83%, the percentage of false positives was 8-21%, and the percentage misclassified was 21-42%. For this age group, a cutoff of ≥ 3 food groups yielded higher sensitivity (69-98%) but poor specificity (25-58%), a higher percentage of false positives (20-41%) and a similar or higher total percentage misclassified (23-44%) except in India. With a cutoff of ≥ 5 food groups, sensitivity was poor (4-60%), specificity was high (86-99%), the percentage of false positives was low (0-4%), and the percentage misclassified was 32-50%.

For non-breastfed infants at 6-11 mo who did not receive fortified products (Table 11), the cutoff of ≥ 4 food groups yielded sensitivity of 47%, specificity of 87%, percentage false positives of 11%, and a total percentage misclassified of 17%. For non-breastfed children at 12-23 mo (Table 12), the cutoff of ≥ 4 food groups yielded sensitivity of 31-98%, specificity of 16-76%,

[3] In this case, sensitivity is defined as the percentage of children with higher MMDA (≥ 75%) who are identified correctly by the food group diversity indicator. Specificity is defined as the percentage of children with lower MMDA (< 75%) who are correctly identified by the food group diversity indicator.

percentage false positives of 5-21%, and a total percentage misclassified of 13-55%. For this subgroup, the cutoff with the best balance between sensitivity and specificity differed by site: ≥ 4 food groups for the Philippines, Madagascar, and Peru-Trujillo, ≥ 3 food groups for India, and ≥ 5 food groups in Brazil. This shows that for non-breastfed children, there is inconsistency across sites in the best cutoff to use for food group diversity for predicting MMDA ≥ 75%. For non-breastfed children who received fortified products (the Philippines only), the AUC value (0.57) was barely significant, and there was no cutoff that resulted in adequate sensitivity + specificity.

3.3 Combinations of "sentinel" food groups as predictors of MMDA-no iron

To screen for potential indicators of MMDA-no iron ≥ 75%, we considered those combinations of sentinel food groups for which the sum of sensitivity plus specificity was ≥ 1.25. Although this is an arbitrary cutoff, it is a criterion that is less dependent on sample size than is a test of statistical significance of the AUC, and it was used simply to narrow down the number of potential indicators to be considered. Tables 13 (breastfed) and 14 (non-breastfed) show the results for both the individual food groups and the combinations that met this criterion, and Tables 15 and 16 compare the AUC values across these individual food groups and their combinations. For the 18 site/age/feeding mode subgroups (excluding children who received fortified products), the above criterion was met by the individual animal source foods (ASF) indicator for 10 subgroups. The situation was slightly better for the combination of ASF and fruits or vegetables (ASF + F/V), which met the criterion for 12 subgroups, and for the combination of dairy and fruits or vegetables (Dairy + F/V), which met the criterion for 11 subgroups. In addition, the AUC values were generally slightly higher for these combinations than for ASF alone. Of the two combination indicators, ASF + F/V performed better than Dairy + F/V among breastfed children, whereas the opposite was true for non-breastfed children. For breastfed children, the above criterion was met by ASF + F/V for all but one subgroup (Malawi, 6-11 mo). In the other breastfed subgroups, at 6-11 mo sensitivity of ASF + F/V was 42-83%, specificity was 53-96% and the total percentage misclassified was 9-36%, and at 12-23 mo sensitivity was 53-93%, specificity was 45-75% and the total percentage misclassified was 21-36%. For non-breastfed children, the ASF + F/V indicator met the above criterion in only one of the six subgroups (Peru-Trujillo at 12-23 mo, where sensitivity was 92% but specificity was only 33%). By contrast, the Dairy + F/V indicator met the criterion in four of the six subgroups of non-breastfed children, although there was wide variability in sensitivity (38-97%), specificity (32-91%), and total percentage misclassified (14-34%).

3.4 The relationship between number of milk feeds and the quantity consumed by non-breastfed children

Data on the number of feedings of milk products and the quantity consumed by non-breastfed children were available for three sites: India (12-23 mo), Peru-Trujillo (6-18 mo), and Brazil (12-23 mo) (Table 17). In India, data were available for 1,189 feedings during 319 child days. The median energy intake per feed was 77 kcal (interquartile range 50-117 kcal) and was similar between age groups (74 kcal at 12-17 mo and 80 kcal at 18-23 mo). These values include both milk and yogurt feeds. Yogurt feeds averaged 42 kcal (compared to 79 kcal for milk feeds), but they were a small proportion of the total number of milk product feeds. Average energy intake was larger when taken alone (89 kcal/feed) than when the milk product was part of a recipe (37 kcal/feed). In Peru-Trujillo, data were available for 2,161 feedings during 476 child days. The median energy intake per feed was reportedly 120 kcal (interquartile range 98-156 kcal) and was lower for infants 6-11 mo (111 kcal) than for children 12-18 mo (130 kcal). Data were not available for categorizing feedings into milk alone vs. milk as part of a recipe. In Brazil, data were available for 315 feedings during 76 child-days. Nearly all of the feedings were fluid milk. Median energy intake per feed was 150 kcal (interquartile range 125-163 kcal).

Figure 7 shows the energy intake from milk only, when consumed alone (if known), by number of feedings. In all three sites, roughly half the children received 3-4 milk feeds per day (54% in India and Brazil, and 43% in Peru). In India, fewer than 3 feeds were reported for 20% of child-days, as compared to 10-11% in the two Latin American sites. Conversely, frequencies of 5 or more feeds were less common in India (26%) compared to Brazil (35%) and Peru-Trujillo (47%).

Figure 7 shows a linear relationship between number of milk feeds and energy intake from milk, as would be expected. However, intakes were generally lower in India at any given number of feeds. Median intake was similar among sites when there were 3 feedings per day, at approximately 300-400 kcal/day. This is also the “target” range for energy from milk if the goal is to achieve an intake similar to the average energy from breast milk consumed by breastfed infants (~400 kcal/day at 6-11 mo and ~350 kcal/day at 12-23 mo).

In addition to examining the relationship between frequency of dairy product feeds and energy intakes by country and by age group, we assessed the potential usefulness of a dichotomous indicator for dairy product intake (i.e., whether or not the child received any dairy product the previous day), for non-breastfed infants and children. Table 18 shows considerable variability in energy intakes per day from dairy products, both within and between study sites. We also examined the proportion of children below illustrative energy cutoffs. In the Latin American sites, nearly 90% of children who received dairy products received at least 300 kcal; approximately ¾ received at least 400 kcal. However, in India, the majority of children (60%) received fewer than 300 kcal. The results for India include both milk and yogurt, whether taken alone or in recipes. Results (not shown) were similar for milk only, and for milk taken alone (not in recipes). Similarly, results for Peru include both milk and infant formula, but results are similar when only milk was considered. Only milk, and no formula, was reported in Brazil.

4. DISCUSSION AND CONCLUSIONS

4.1 Dietary diversity as an indicator of diet quality using MMDA-no iron

As expected, exclusion of iron intake from the calculation of MMDA increased the mean values of dietary quality (MMDA-no iron) and the proportion of children above the cutoff of 75%, defined as “adequate” dietary quality. For all subgroups except those consuming fortified products, the correlation coefficients between dietary diversity (FGI7) and MMDA-no iron were statistically significant; they ranged from 0.38 to 0.77 for breastfed children and from 0.25 to 0.56 for non-breastfed children. These correlations were similar to what was observed previously using MMDA as the outcome. As seen before, the correlations with FGI8 were weaker than with FGI7, and for this reason the discussion will focus on FGI7.

The ROC analyses showed that dietary diversity had predictive power for all subgroups (except those consuming fortified products), indicated by significance tests of the AUC. The AUC values were generally higher for MMDA-no iron ≥ 75% than they were in the previous analyses with MMDA ≥ 75%, except in India.

As explained in the Results section, when assessing the percentage of children with “adequate” diets, rather than the percentage “at risk,” it is preferable to minimize the number of false positives, so as to avoid concluding that diets are adequate when they really are not. This means favoring specificity over sensitivity. We also note that a preference for specificity may be considered appropriate given that 75% is not an extremely high cut-off for defining adequacy. On this basis, the best cutoff point for predicting MMDA-no iron ≥ 75% was ≥ 4 food groups. This cutoff performed reasonably well for breastfed infants 6-11 mo who did not receive fortified products, although sensitivity was poor in most sites, especially Bangladesh and the Philippines. The results were less satisfactory for children in the second year of life and for non-breastfed children. The cutoff point of ≥ 3 gives consistently higher sensitivity, but at the expense of unacceptably low specificities in many sites, more false positives, and generally higher total percentages misclassified. As was seen before, dietary diversity was not a good predictor of dietary quality for the infants in the Philippines who received fortified products, regardless of the food group diversity cutoff used.

A key question is whether the above results are strong enough to warrant adoption of an indicator intended to predict *adequate* dietary quality (assuming that adequate iron intake is assured in some other way) rather than *poor* dietary quality. In the previous analyses with MMDA < 50%, the cutoff of ≤ 2 food groups when applied to the subgroup with the strongest results (breastfed infants 6-11 mo who did not consume fortified products) yielded sensitivity of 63-92%, specificity of 43-90%, and a total percentage misclassified of 13-28% (Working Group 2006). The new results with MMDA ≥ 75% and a cutoff of ≥ 4 food groups, when applied to the same subgroup, yielded sensitivity of 25-72%, specificity of 70-97%, and a total percentage misclassified of 9-38%. In either scenario, the results were not as good for children in the second year of life and for non-breastfed children. Overall, the technical qualities (Se + Sp; % misclassified) for the two approaches are in the same ballpark, and either one requires us to accept some misclassification. Therefore, it is a matter of judgment whether an indicator intended to predict adequate dietary quality would be more useful than one based on predicting poor dietary quality. Making this judgment requires taking into account several other considerations when selecting an indicator, including ease of use and interpretation as well as usefulness for advocacy and evaluation.

4.2 Combinations of sentinel food groups as indicators of dietary quality

When predicting MMDA-no iron ≥ 75%, the AUC values were generally slightly higher for the combinations of ASF + F/V or Dairy + F/V than for ASF alone. Of these two combination indicators, ASF + F/V performed better than Dairy + F/V among breastfed children, whereas the opposite was true for non-breastfed children. These results indicate that these indicators are reasonably good markers of dietary quality for certain subgroups in some sites. However, as was found for ASF alone in the previous analyses (Working Group 2006), there was insufficient consistency across sites to consider either of them as a universal indicator of mean micronutrient density adequacy, even with iron excluded.

4.3 Milk feeding frequency and energy intake from milk in non-breastfed children

The results indicated that 3 milk feedings per day would be necessary to reach an average intake of 300-400 kcal from milk. Because most children will probably not consume more than 180-240 mL/feed, which would be equivalent to ~100-150 kcal/feed if consumed as liquid whole cow's milk, 3 milk feedings would be a reasonable cutoff for an indicator meant to predict an average intake of 300-450 kcal per day from milk. The main issue is what the target range should be for energy intake from milk by non-breastfed children. Average energy intake from breast milk in developing countries is approximately 400 kcal/day at 6-11 mo and 350 kcal/day at 12-23 mo. To reach this level, 3 milk feedings per day would be appropriate, but from a nutritional perspective it is certainly possible that adequate dietary quality can be achieved with less than this (Dewey, Cohen, and Rollins 2004). Unfortunately, there is insufficient information from research studies to allow us to predict the relationship between the *quantity* of milk consumed and growth or functional outcomes in non-breastfed children.

4.4 Conclusions

We draw the following conclusions from these additional analyses:

1) Further discussion with broader stakeholder groups is needed to decide whether to adopt an indicator of adequate dietary quality, for example based on a cutoff of ≥ 4 food groups. If this decision is taken, there will need to be a separate indicator for adequacy of iron intake, such as consumption of iron-fortified products designed for infants and young children. The discussion on which indicator of dietary diversity is best (i.e., an indicator of *adequate* vs. *poor* dietary quality) should include consideration of the trade-offs mentioned previously (sensitivity vs. specificity), the proposed uses for the indicators, and the likely interpretation of results (regardless of our intentions about how the indicators should be interpreted).

2) Although combinations of sentinel food groups may be useful indicators of adequate dietary quality in some settings, there is insufficient consistency across sites to recommend their adoption as universal indicators for global use.

3) Further discussion is needed to agree on an indicator for milk feeding frequency among non-breastfed children. To achieve intakes comparable to those of breastfed children, 3 milk feedings per day is a reasonable cutoff, but this decision needs to take into account the purposes and interpretation of the proposed indicator.

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TABLES

Table 1. Study dates and sample sizes (child-days), by country, age, and breastfeeding status

Country/age (months)	Date of data collection	Total sample size (n)	Sample size by breastfeeding status and age group	
			Breastfed	Non-breastfed
Africa				
Ghana	1994-1996	394		
6-8			220	–
9-11			174	–
Madagascar	2004	1,594		
6-8			383	9
9-11			309	16
12-23			693	184
Malawi	1998-1999	398		
6-8			66	–
9-11			92	–
12-23			240	–
Asia				
Bangladesh	1999	124		
6-8			54	–
9-11			70	–
India	1998-2002	1,486		
12-23			1,151	335
Philippines	1986-1988	2,654		
6-8			703	665
9-11			582	704
12-23				
Latin America				
Brazil	2002-2003	80		
12-23			–	80
Honduras	1997	709		
6-8			709	–
Peru (Huascar)	1982-1984	639		
6-8			365	–
9-11			274	–
Peru (Trujillo)	1999-2002	3,052		
6-8			905	50
9-11			476	60
12-18			1,182	379

Table 2. Mean Micronutrient Density Adequacy (MMDA-no iron), by country, age group, and breastfeeding status[a]

	Breastfed children			Non-breastfed children		
Countries	**6–8 mo**	**9–11 mo**	**12–23 mo**	**6–8 mo**	**9–11 mo**	**12–23 mo**
Africa						
Ghana	51 (15)	66 (16)	–	–	–	–
Madagascar	62 (19)	72 (18)	70 (17)	68 (23)	72 (13)	72 (14)
Malawi	57 (22)	76 (16)	72 (14)	–	–	–
Asia						
Bangladesh	39 (21)	54 (18)	–	–	–	–
India	–	–	72 (17)	–	–	77 (12)
Philippines	51 (19)	55 (17)	–	69 (18)	67 (15)	–
No fortified foods	47 (17)	53 (15)	–	58 (14)	62 (12)	–
Fortified foods	74 (12)	83 (9)	–	82 (13)	83 (11)	–
Latin America						
Brazil	–	–	–	–	–	80 (9)
Honduras	71 (16)	–	–	–	–	–
Peru (Huascar)	62 (21)	69 (18)	–	–	–	–
Peru (Trujillo)	78 (14)	84 (13)	80 (15)	92 (6)	94 (8)	88 (10)

[a] Standard deviation in the parentheses.

Table 3. Percent of sample below Mean Micronutrient Density Adequacy (MMDA-no iron) 50%, by country, age group, and breastfeeding status

	Breastfed children			Non-breastfed children		
Countries	**6–8 mo**	**9–11 mo**	**12–23 mo**	**6-8 mo**	**9-11 mo**	**12-23 mo**
Africa						
Ghana	56	15	–	–	–	–
Madagascar[a]	26	13	13	22	6	7.1
Malawi	41	10	9			
Asia						
Bangladesh	67	45	–	–	–	–
India	–	–	11.1	–	–	4
Philippines	48	42	–	14	10	–
No fortified foods	57	45	–	23	13	–
Fortified foods	4	0.0	–	3	1	–
Latin America						
Brazil	–	–	–	–	–	1.3
Honduras	11	–	–	–	–	–
Peru (Huascar)	25	13	–	–	–	–
Peru (Trujillo)	5	3	3.8	0.0	2	1.3

[a] In Madagascar, very few infants were not breastfed (9 infants aged 6-8 mo and 16 infants aged 9-11 mo).

Table 4. Percent of sample at or above Mean Micronutrient Density Adequacy (MMDA-no iron) 75%, by country, age group, and breastfeeding status

	Breastfed children			Non-breastfed children		
Countries	**6–8 mo**	**9–11 mo**	**12–23 mo**	**6–8 mo**	**9–11 mo**	**12–23 mo**
Africa						
Ghana	9	28	–	–	–	–
Madagascar[a]	30	49	41	56	38	47
Malawi	30	63	48	–	–	–
Asia						
Bangladesh	6	13	–	–	–	–
India	–	–	52	–	–	69
Philippines	14	12	–	38	30	–
No fortified foods	6	7	–	8	14	–
Fortified foods	55	84	–	73	77	–
Latin America						
Brazil	–	–	–	–	–	76
Honduras	47	–	–	–	–	–
Peru (Huascar)	31	43	–	–	–	–
Peru (Trujillo)	72	81	71	98	98	92

[a] In Madagascar, very few infants were not breastfed (9 infants aged 6-8 mo and 16 infants aged 9-11 mo).

Table 5. Association (correlation coefficient) between Mean Micronutrient Density Adequacy (MMDA-no iron) and dietary diversity (FGI7), by country, age group, and breastfeeding status[a]

	Breastfed children			Non-breastfed children		
Countries	**6–8 mo**	**9–11 mo**	**12–23 mo**	**6–8 mo**	**9–11 mo**	**12–23 mo**
Africa						
Ghana	0.77	0.55	–	–	–	–
Madagascar	0.55	0.59	0.54			0.48[b]
Malawi	0.64	0.34	0.41	–	–	–
Asia						
Bangladesh	0.73	0.72	–	–	–	–
India	–	–	0.38	–	–	0.32
Philippines	0.65	0.66	–	0.25	0.34	–
No fortified foods	0.70	0.68	–	0.56	0.51	–
Fortified foods	0.51	0.20[c]	–	0.05[c]	0.08[c]	
Latin America						
Brazil	–	–	–	–	–	0.31
Honduras	0.41	–	–	–	–	–
Peru (Huascar)	0.61	0.53	–	–	–	–
Peru (Trujillo)	0.60	0.65	0.65	0.35	0.44	0.51

[a] All correlations are significant ($p < 0.05$), except where noted.

[b] Result for all children 6 – 23 mo; n for < 12 mo = 25 and n for ≥ 12 mo = 184.

[c] Correlation not significant ($p > 0.05$).

Table 6. Area under the curve (AUC) for FGI7 when Mean Micronutrient Density Adequacy (MMDA-no iron) cutoff is 75% [a]

	Breastfed children				Non-breastfed children			
	6–8 mo	**9–11 mo**	**6–11 mo**	**12–23 mo**	**6–8 mo**	**9–11 mo**	**6–11 mo**	**12–23 mo**
<u>**Africa**</u>								
Ghana	0.88*** (0.03)	0.79*** (0.04)	0.83*** (0.03)	–	–	–	–	–
Madagascar	0.70*** (0.03)	0.74*** (0.03)	0.73*** (0.02)	0.73*** (0.02)	–	–	–	0.69*** (0.04)[b]
Malawi	0.74** (0.06)	0.69** (0.06)	0.73*** (0.04)	0.63*** (0.04)	–	–	–	–
<u>**Asia**</u>								
Bangladesh[c]	–	0.89*** (0.05)	0.91*** (0.03)	–	–	–		–
India	–	–		0.65*** (0.02)	–	–		0.59* (0.01)
Philippines	0.78*** (0.02)	0.77*** (0.03)	0.77*** (0.02)	–	0.57** (0.02)	0.64*** (0.02)	0.60*** (0.02)	–
Not fortified foods	0.79*** (0.04)	0.78*** (0.04)	0.78*** (0.03)	–	0.80*** (0.04)	0.76*** (0.03)	0.77*** (0.02)	–
Fortified foods	0.76*** (0.04)	0.73 (0.10)	0.77*** (0.04)	–	0.56 (0.04)	0.59 (0.05)	0.57* (0.03)	–
<u>**Latin America**</u>								
Brazil	–	–	–	–	–	–	–	0.72** (0.07)
Honduras	0.67*** (0.02)	–	–	–	–	–	–	–
Peru (Huascar)	0.72*** (0.03)	0.72*** (0.03)	0.73*** (0.02)	–	–	–	–	–
Peru (Trujillo)[d]	0.81*** (0.02)	0.88*** (0.02)	0.83*** (0.01)	0.82*** (0.01)	–	–	0.79 (0.14)	0.79*** (0.04)

*** Significant at $p < 0.001$.

** Significant at $p < 0.01$.

* Significant at $p < 0.05$.

[a] Standard errors in parentheses.

[b] Result for all children 6 – 23 mo; n for < 12 mo = 25 and n for ≥ 12 mo = 184.

[c] In Bangladesh results are not reported for breastfed children 6-8 mo, because only 3 children had MMDA-no iron ≥ 75%.

[d] In Peru – Trujillo, results are not reported for non-breasted children 6-8 and 9-11 mo, because only 2 children had MMDA-no iron < 75%.

Table 7. Comparing area under the curve (AUC) for FGI7 for two versions of MMDA using cutoff of ≥ 75% (old includes iron and new excludes iron): Breastfed infants and children, by age group[a]

	Breastfed children							
	6–8 mo		9–11 mo		6–11 mo		12–23 mo	
	Old	New	Old	New	Old	New	Old	New
Africa								
Ghana	0.90*** (*0.03*)	0.88*** (0.03)	0.76*** (*0.04*)	0.79*** (0.04)		0.83*** (0.03)	–	–
Madagascar	0.62** (0.04)	0.70*** (0.03)	0.70*** (0.03)	0.74*** (0.03)		0.73*** (0.02)	0.73*** (0.02)	0.73*** (0.02)
Malawi	0.75** (0.06)	0.74** (0.06)	0.56 (0.06)	0.69** (0.06)		0.73*** (0.04)	0.64*** (0.03)	0.63*** (0.04)
Asia								
Bangladesh	–[b]	0.94* (0.04)	0.88** (0.09)	0.89*** (0.05)		0.91*** (0.03)	–	–
India	–	–	–	–			0.77*** (0.01)	0.65*** (0.02)
Philippines	0.72*** (0.03)	0.78*** (0.02)	0.75*** (0.03)	0.77*** (0.03)		0.77*** (0.02)	–	–
Not fortified foods	0.67* (0.07)	0.79*** (0.04)	0.78*** (0.05)	0.78*** (0.04)		0.78*** (0.03)	–	–
Fortified foods[c]		0.76*** (0.04)		0.73 (0.10)	0.68*** (0.04)	0.77*** (0.04)	–	–
Latin America								
Brazil	–	–	–	–		–	–	–
Honduras	0.68*** (0.02)	0.67*** (0.02)	–	–		–	–	–
Peru (Huascar)	0.74*** (0.04)	0.72*** (0.03)	0.69*** (0.03)	0.72*** (0.03)		0.73*** (0.02)	–	–
Peru (Trujillo)[d]	0.68*** (0.02)	0.81*** (0.02)	0.74*** (0.02)	0.88*** (0.02)		0.83*** (0.01)	0.77*** (0.01)	0.82*** (0.01)

*** Significant at $p < 0.001$.

** Significant at $p \leq 0.01$.

* Significant at $p < 0.05$.

[a] Standard errors in parentheses.

[b] In Bangladesh, results are not reported for breastfed children 6-8 mo, because only 3 children had MMDA-no iron ≥ 75%.

[c] In previous report, the results were not presented separately for 6-8 and 9-11 mo.

[d] In Peru – Trujillo, results are not reported for non-breasted children 6-8 and 9-11 mo, because only 2 children had MMDA-no iron < 75%.

Table 8. Comparing area under the curve (AUC) for FGI7 for two versions of MMDA using cutoff of ≥ 75% (old includes iron and new excludes iron): Non-breastfed infants and children, by age group[a]

	Non breastfed children							
	6–8 mo		9–11 mo		6–11 mo		12–23 mo	
	Old	New	Old	New	Old	New	Old	New
Africa								
Ghana	–	–	–	–		–	–	–
Madagascar	–	–	–	–		–	0.68*** (0.04)[b]	0.69*** (0.04)[b]
Malawi	–	–	–	–		–	–	–
Asia								
Bangladesh	–	–	–	–				–
India	–	–	–	–			0.75*** (0.03)	0.59* (0.01)
Philippines	0.57* (0.02)	0.57** (0.02)	0.65*** (0.02)	0.64*** (0.02)		0.60*** (0.02)	–	–
Not fortified foods	0.81*** (0.04)	0.80*** (0.04)	0.81*** (0.03)	0.76*** (0.03)		0.77*** (0.02)	–	–
Fortified foods	0.56 (0.03)	0.56 (0.04)	0.59 (0.04)	0.59 (0.05)		0.57* (0.03)	–	–
Latin America						–		
Brazil	–	–	–	–		–	0.61 (0.06)	0.72** (0.07)
Honduras	–	–	–	–		–	–	–
Peru (Huascar)	–	–	–	–		–	–	–
Peru (Trujillo)[c]	–	–	–	–		0.79 (0.14)	0.77*** (0.04)	0.79*** (0.04)

*** Significant at $p < 0.001$.

** Significant at $p \leq 0.01$.

* Significant at $p < 0.05$.

[a] Standard error in parentheses.

[b] Result for all children 6 – 23 mo; n for < 12 mo = 25 and n for ≥ 12 mo = 184.

[c] In Peru – Trujillo, results are not reported for non-breasted children 6-8 and 9-11 mo, because only 2 children had MMDA-no iron < 75%.

Table 9. Sensitivity/specificity analysis of the relationship between food group diversity (FGI7) and Mean Micronutrient Density Adequacy (using MMDA-no iron ≥ 75% cutoff point), by FGI7 cutoff for breastfed infants 6-11 mo

Cutoffs	Sensitivity	Specificity	Positive predictive value	Proportion of false positives	Proportion of false negatives	Total proportion misclassified
Africa						
Ghana						
≥ 1	1.00	0.00	0.18	0.82	0.00	0.82
≥ 2	1.00	0.10	0.19	0.74	0.00	0.74
≥ 3	0.93	0.56	0.32	0.36	0.01	0.37
≥ 4	0.63	0.87	0.52	0.10	0.07	0.17
≥ 5	0.24	0.97	0.62	0.03	0.14	0.16
≥ 6	0.03	1.00	0.67	0.00	0.17	0.18
≥ 7						
Madagascar						
≥ 1	1.00	0.03	0.39	0.59	0.00	0.59
≥ 2	0.99	0.22	0.44	0.48	0.00	0.48
≥ 3	0.83	0.47	0.50	0.32	0.07	0.39
≥ 4	0.50	0.81	0.63	0.11	0.19	0.31
≥ 5	0.15	0.98	0.81	0.01	0.33	0.34
≥ 6	0.02	1.00	0.83	0.00	0.38	0.38
≥ 7	0.00	1.00	-	0.00	0.39	0.39
Malawi						
≥ 1	1.00	0.00	0.49	0.51	0.00	0.51
≥ 2	1.00	0.36	0.60	0.32	0.00	0.32
≥ 3	0.74	0.53	0.60	0.24	0.13	0.37
≥ 4	0.44	0.83	0.71	0.09	0.28	0.37
≥ 5	0.14	0.98	0.85	0.01	0.42	0.44
≥ 6	0.05	1.00	1.00	0.00	0.47	0.47
≥ 7	0.00	1.00	-	0.00	0.49	0.49
Asia						
Bangladesh						
≥ 1	1.00	0.00	0.10	0.90	0.00	0.90
≥ 2	1.00	0.47	0.18	0.47	0.00	0.47
≥ 3	0.92	0.86	0.42	0.13	0.01	0.14
≥ 4	0.25	0.97	0.50	0.03	0.08	0.10
≥ 5						
Philippines						
All child-days (w/ and w/o fortified products)						
≥ 1	1.00	0.00	0.13	0.87	0.00	0.87
≥ 2	0.96	0.39	0.19	0.53	0.01	0.53
≥ 3	0.65	0.75	0.28	0.22	0.05	0.26
≥ 4	0.26	0.95	0.44	0.04	0.10	0.14
≥ 5	0.04	0.99	0.40	0.01	0.13	0.13
≥ 6	0.01	1.00	1.00	0.00	0.13	0.13
≥ 7	0.00	1.00	-	0.00	0.13	0.13

(continued)

Cutoffs	Sensitivity	Specificity	Positive predictive value	Proportion of false positives	Proportion of false negatives	Total proportion misclassified
Non-fortified						
≥ 1	1.00	0.00	0.06	0.94	0.00	0.94
≥ 2	0.96	0.39	0.09	0.57	0.00	0.57
≥ 3	0.68	0.75	0.15	0.24	0.02	0.26
≥ 4	0.32	0.95	0.29	0.05	0.04	0.09
≥ 5	0.04	0.99	0.25	0.01	0.06	0.07
≥ 6	0.01	1.00	1.00	0.00	0.06	0.06
≥ 7	0.00	1.00	-	0.00	0.06	0.06
Fortified						
≥ 1	1.00	0.00	0.63	0.37	0.00	0.37
≥ 2	0.96	0.36	0.72	0.24	0.02	0.26
≥ 3	0.63	0.79	0.83	0.08	0.23	0.31
≥ 4	0.22	0.95	0.88	0.02	0.49	0.51
≥ 5	0.03	1.00	1.00	0.00	0.61	0.61
≥ 6	0.00	1.00	-	0.00	0.63	0.63
≥ 7	0.00	1.00	-	0.00	0.63	0.63
Latin America						
Peru (Huascar)						
≥ 1	1.00	0.00	0.36	0.64	0.00	0.64
≥ 2	0.99	0.19	0.41	0.51	0.00	0.52
≥ 3	0.88	0.40	0.46	0.38	0.05	0.42
≥ 4	0.62	0.73	0.57	0.17	0.14	0.31
≥ 5	0.21	0.95	0.70	0.03	0.29	0.32
≥ 6	0.04	0.99	0.80	0.00	0.35	0.35
≥ 7						
Peru (Trujillo)						
≥ 1	1.00	0.01	0.75	0.25	0.00	0.25
≥ 2	1.00	0.18	0.78	0.21	0.00	0.21
≥ 3	0.99	0.50	0.85	0.13	0.01	0.14
≥ 4	0.72	0.81	0.92	0.05	0.21	0.26
≥ 5	0.37	0.95	0.96	0.01	0.48	0.49
≥ 6	0.10	1.00	0.99	0.00	0.68	0.68
≥ 7	0.01	1.00	1.00	0.00	0.74	0.74

Table 10. Sensitivity/specificity analysis of the relationship between food group diversity (FGI7) and Mean Micronutrient Density Adequacy (using MMDA-no iron ≥ 75% cutoff point), by FGI7 cutoff for breastfed children 12-23 mo

Cutoffs	Sensitivity	Specificity	Positive predictive value	Proportion of false positives	Proportion of false negatives	Total proportion misclassified
Africa						
Madagascar						
≥ 1	1.00	0.00	0.41	0.58	0.00	0.58
≥ 2	1.00	0.07	0.43	0.55	0.00	0.55
≥ 3	0.92	0.31	0.48	0.41	0.03	0.44
≥ 4	0.66	0.69	0.60	0.18	0.14	0.32
≥ 5	0.30	0.93	0.75	0.04	0.29	0.33
≥ 6	0.06	0.99	0.85	0.00	0.39	0.39
≥ 7	0.00	1.00	0.50	0.00	0.41	0.41
Malawi						
≥ 1	1.00	0.00	0.48	0.53	0.00	0.53
≥ 2	1.00	0.08	0.50	0.48	0.00	0.48
≥ 3	0.86	0.30	0.53	0.37	0.07	0.43
≥ 4	0.55	0.60	0.56	0.21	0.21	0.42
≥ 5	0.18	0.95	0.77	0.03	0.39	0.42
≥ 6	0.02	1.00	1.00	0.00	0.47	0.47
≥ 7	0.00	1.00	-	0.00	0.48	0.48
Asia						
India						
≥ 1	1.00	0.00	0.52	0.48	0.00	0.48
≥ 2	0.95	0.13	0.54	0.42	0.03	0.45
≥ 3	0.69	0.58	0.64	0.20	0.16	0.36
≥ 4	0.34	0.83	0.68	0.08	0.34	0.42
≥ 5	0.04	0.99	0.85	0.00	0.50	0.50
≥ 6	0.00	1.00	1.00	0.00	0.52	0.52
≥ 7	0.00	1.00	-	0.00	0.52	0.52
Latin America						
Peru (Trujillo)						
≥ 1	1.00	0.00	0.71	0.29	0.00	0.29
≥ 2	1.00	0.05	0.72	0.28	0.00	0.28
≥ 3	0.98	0.25	0.76	0.22	0.01	0.23
≥ 4	0.88	0.56	0.83	0.13	0.08	0.21
≥ 5	0.60	0.86	0.91	0.04	0.29	0.32
≥ 6	0.25	1.00	1.00	0.00	0.53	0.53
≥ 7	0.04	1.00	1.00	0.00	0.68	0.68

Table 11. Sensitivity/specificity analysis of the relationship between food group diversity (FGI7) and Mean Micronutrient Density Adequacy (using MMDA-no iron 75% cutoff point), by FGI7 cutoff for non-breastfed 6-11 infants mo[a]

Cutoffs	Sensitivity	Specificity	Positive predictive value	Proportion of false positives	Proportion of false negatives	Total proportion misclassified
Asia						
Philippines						
All child-days (w/ and w/o fortified products)						
≥ 1	1.00	0.00	0.34	0.66	0.00	0.66
≥ 2	0.97	0.05	0.35	0.63	0.01	0.64
≥ 3	0.58	0.57	0.41	0.28	0.14	0.42
≥ 4	0.24	0.88	0.51	0.08	0.26	0.34
≥ 5	0.06	0.98	0.63	0.01	0.32	0.33
≥ 6	0.01	1.00	0.75	0.00	0.34	0.34
≥ 7	0.00	1.00	-	0.00	0.34	0.34
Non-fortified						
≥ 1	1.00	0.01	0.11	0.88	0.00	0.88
≥ 2	1.00	0.06	0.12	0.84	0.00	0.84
≥ 3	0.87	0.56	0.20	0.39	0.01	0.40
≥ 4	0.47	0.87	0.32	0.11	0.06	0.17
≥ 5	0.14	0.98	0.45	0.02	0.10	0.12
≥ 6	0.02	1.00	0.67	0.00	0.11	0.11
≥ 7	0.00	1.00	-	0.00	0.11	0.11
Fortified						
≥ 1	1.00	0.00	0.74	0.26	0.00	0.26
≥ 2	0.96	0.01	0.74	0.25	0.03	0.28
≥ 3	0.50	0.63	0.80	0.09	0.37	0.46
≥ 4	0.18	0.92	0.87	0.02	0.61	0.63
≥ 5	0.04	0.99	0.94	0.00	0.71	0.71
≥ 6	0.00	1.00	1.00	0.00	0.74	0.74
≥ 7	0.00	1.00	-	0.00	0.74	0.74

[a] Results are not reported for if there were too few non-breastfed children < 12 mo (several sites) or if too few non-breastfed children < 12 mo had MMDA-no iron < 75% (Peru-Trujillo).

Table 12. Sensitivity/specificity analysis of the relationship between food group diversity (FGI7) and Mean Micronutrient Density Adequacy (using MMDA-no iron ≥ 75% cutoff point), by FGI7 cutoff for non-breastfed children 12-23 mo

Cutoffs	Sensitivity	Specificity	Positive predictive value	Proportion of false positives	Proportion of false negatives	Total proportion misclassified
Africa						
Madagascar						
≥ 1	1.00	0.00	0.47	0.53	0.00	0.53
≥ 2	1.00	0.04	0.48	0.51	0.00	0.51
≥ 3	0.94	0.15	0.50	0.45	0.03	0.47
≥ 4	0.76	0.60	0.63	0.21	0.11	0.33
≥ 5	0.30	0.90	0.72	0.05	0.33	0.39
≥ 6	0.06	1.00	1.00	0.00	0.45	0.45
≥ 7	0.01	1.00	1.00	0.00	0.47	0.47
Asia						
India						
≥ 1	1.00	0.00	0.69	0.31	0.00	0.31
≥ 2	0.94	0.10	0.69	0.28	0.04	0.33
≥ 3	0.66	0.52	0.75	0.15	0.23	0.38
≥ 4	0.31	0.76	0.74	0.08	0.47	0.55
≥ 5	0.03	0.98	0.75	0.01	0.67	0.67
≥ 6	0.00	1.00	-	0.00	0.69	0.69
≥ 7	0.00	1.00	-	0.00	0.69	0.69
Latin America						
Brazil						
≥ 1	1.00	0.00	0.76	0.24	0.00	0.24
≥ 2	1.00	0.00	0.76	0.24	0.00	0.24
≥ 3	1.00	0.11	0.78	0.21	0.00	0.21
≥ 4	0.98	0.16	0.79	0.20	0.01	0.21
≥ 5	0.87	0.42	0.83	0.14	0.10	0.24
≥ 6	0.38	0.89	0.92	0.03	0.48	0.50
≥ 7	0.07	0.79	0.44	0.06	0.67	0.73
Peru (Trujillo)						
≥ 1	1.00	0.00	0.92	0.08	0.00	0.08
≥ 2	1.00	0.03	0.92	0.08	0.00	0.08
≥ 3	0.98	0.17	0.93	0.07	0.02	0.09
≥ 4	0.91	0.40	0.95	0.05	0.08	0.13
≥ 5	0.71	0.77	0.97	0.02	0.27	0.28
≥ 6	0.31	0.97	0.99	0.00	0.64	0.64
≥ 7	0.05	1.00	1.00	0.00	0.87	0.87

Table 13. Sensitivity/specificity analysis of the relationship between intake of sentinel food groups and combinations of groups (1-gram minimum) and Mean Micronutrient Density Adequacy (MMDA-no iron) ≥ 75%, where sum of sensitivity and specificity ≥ 1.25: Breastfed infants and children

	Food group	Sensitivity	Specificity	Positive predictive value	Proportion of false positives	Proportion of false negatives	Total proportion misclassified	Area under the curve (SE)
Africa								
Ghana								
6-11 mo	Animal-source foods	0.87	0.48	0.27	0.43	0.02	0.45	0.67 (0.03)
	Other fruits & veg	0.72	0.80	0.43	0.17	0.05	0.22	0.76 (0.03)
	ASF_vitA	0.60	0.88	0.53	0.09	0.07	0.19	0.74 (0.04)
	ASF_fruits_veg	0.63	0.85	0.47	0.13	0.07	0.19	0.74 (0.04)
Madagascar								
6-11 mo	Dairy	0.43	0.85	0.65	0.09	0.22	0.31	0.64 (0.02)
	ASF_fruits_veg	0.67	0.63	0.53	0.23	0.13	0.35	0.65 (0.02)
	Other fruits & veg	0.88	0.36	0.47	0.39	0.04	0.43	0.62 (0.02)
	dairy_fruits_veg	0.39	0.92	0.76	0.05	0.24	0.28	0.66 (0.02)
12-23 mo	Animal-source foods	0.85	0.53	0.56	0.27	0.06	0.34	0.69 (0.02)
	Dairy	0.43	0.90	0.75	0.06	0.24	0.30	0.66 (0.02)
	ASF_fruits_veg	0.81	0.59	0.58	0.24	0.08	0.32	0.70 (0.02)
	dairy_fruits_veg	0.39	0.92	0.78	0.05	0.25	0.30	0.66 (0.02)
Malawi								
6-11 mo	Vitamin A-rich fruits and vegetables	0.91	0.78	0.80	0.11	0.04	0.16	0.84 (0.03)
	Other fruits & veg	0.91	0.78	0.80	0.11	0.04	0.16	0.56 (0.05)
12-23 mo	Animal-source foods	0.54	0.72	0.64	0.15	0.22	0.36	0.63 (0.04)
	Vitamin A-rich fruits and vegetables	0.84	0.43	0.57	0.30	0.08	0.38	0.64 (0.04)
	Other fruits & veg	0.84	0.43	0.57	0.30	0.08	0.38	0.53 (0.04)
	ASF_vitA	0.39	0.89	0.76	0.06	0.29	0.35	0.64 (0.04)
	ASF_fruits_veg	0.53	0.75	0.65	0.13	0.23	0.36	0.64 (0.04)
Asia								
Bangladesh								
6-11 mo	Animal-source foods	0.67	0.82	0.30	0.16	0.03	0.20	0.74 (0.08)
	Dairy	0.42	0.87	0.26	0.12	0.06	0.18	0.64 (0.09)
	Vitamin A-rich fruits and vegetables	0.50	0.96	0.60	0.03	0.05	0.09	0.73 (0.09)
	Other fruits & veg	0.67	0.75	0.24	0.22	0.03	0.26	0.71 (0.08)
	ASF_vitA	0.42	0.96	0.56	0.03	0.06	0.09	0.69 (0.10)
	Dairy_vitA	0.33	1.00	1.00	0.00	0.07	0.07	0.67 (0.10)
	ASF_fruits_veg	0.42	0.96	0.56	0.03	0.06	0.09	0.69 (0.10)
	dairy_fruits_veg	0.33	1.00	1.00	0.00	0.07	0.07	0.67 (0.10)

(continued)

	Food group	Sensitivity	Specificity	Positive predictive value	Proportion of false positives	Proportion of false negatives	Total proportion misclassified	Area under the curve (SE)
								(continued)
India								
12-23 mo	Animal-source foods	0.99	0.25	0.59	0.36	0.00	0.36	0.62 (0.02)
	Dairy	0.99	0.25	0.59	0.36	0.00	0.36	0.62 (0.02)
	ASF_fruits_veg	0.65	0.73	0.72	0.13	0.18	0.31	0.69 (0.02)
	dairy_fruits_veg	0.65	0.73	0.72	0.13	0.18	0.31	0.69 (0.02)
Philippines								
All child-days (w/ and w/o fortified products								
6-11 mo	Animal-source foods	0.97	0.49	0.23	0.44	0.00	0.44	0.73 (0.02)
	Dairy	0.85	0.70	0.30	0.26	0.02	0.28	0.78 (0.02)
	Other fruits & veg	0.44	0.84	0.30	0.13	0.07	0.21	0.64 (0.02)
	ASF_fruits_veg	0.42	0.91	0.43	0.07	0.08	0.15	0.67 (0.03)
	dairy_fruits_veg	0.38	0.96	0.61	0.03	0.08	0.11	0.67 (0.03)
Philippines (non-fortified)								
6-11 mo	Animal-source foods	0.93	0.50	0.11	0.47	0.00	0.48	0.71 (0.03)
	Dairy	0.63	0.72	0.13	0.26	0.02	0.29	0.68 (0.03)
	Other fruits & veg	0.63	0.84	0.21	0.15	0.02	0.17	0.74 (0.04)
	ASF_fruits_veg	0.57	0.91	0.30	0.08	0.03	0.11	0.74 (0.04)
	dairy_fruits_veg	0.49	0.97	0.48	0.03	0.03	0.06	0.73 (0.04)
Philippines (fortified)								
6-11 mo	Animal-source foods	1.00	0.39	0.73	0.23	0.00	0.23	0.70 (0.05)
	Dairy	0.99	0.44	0.75	0.21	0.01	0.21	0.72 (0.05)
<u>Latin America</u>								
Honduras								
6-8 mo	ASF_vitA	0.75	0.56	0.60	0.23	0.12	0.35	0.66 (0.02)
	ASF_fruits_veg	0.77	0.53	0.59	0.25	0.11	0.36	0.65 (0.02)
Peru (Huascar)								
6-11 mo	Animal-source foods	0.87	0.41	0.46	0.38	0.05	0.42	0.64 (0.02)
	Vitamin A-rich fruits and vegetables	0.82	0.48	0.47	0.33	0.07	0.40	0.65 (0.02)
	ASF_vitA	0.61	0.68	0.52	0.20	0.14	0.34	0.65 (0.02)
	ASF_fruits_veg	0.78	0.57	0.51	0.27	0.08	0.35	0.68 (0.02)

(continued)

	Food group	Sensitivity	Specificity	Positive predictive value	Proportion of false positives	Proportion of false negatives	Total proportion misclassified	Area under the curve (SE)
Peru (Trujillo)								
6-11 mo	Animal-source foods	0.94	0.53	0.86	0.12	0.04	0.16	0.73 (0.02)
	Dairy	0.77	0.59	0.85	0.10	0.17	0.28	0.70 (0.02)
	Vitamin A-rich fruits and vegetables	0.77	0.59	0.85	0.10	0.17	0.28	0.68 (0.02)
	ASF_vitA	0.71	0.78	0.91	0.05	0.22	0.27	0.75 (0.02)
	Dairy_vitA	0.42	0.93	0.95	0.02	0.44	0.45	0.67 (0.02)
	ASF_fruits_veg	0.83	0.68	0.89	0.08	0.12	0.20	0.76 (0.02)
	dairy_fruits_veg	0.49	0.90	0.94	0.02	0.38	0.40	0.70 (0.01)
12-23 mo	Animal-source foods	0.99	0.32	0.78	0.20	0.01	0.20	0.66 (0.02)
	Dairy	0.65	0.89	0.93	0.03	0.25	0.28	0.77 (0.01)
	Vitamin A-rich fruits and vegetables	0.72	0.55	0.80	0.13	0.20	0.33	0.63 (0.02)
	ASF_vitA	0.71	0.70	0.85	0.09	0.21	0.29	0.70 (0.02)
	Dairy_vitA	0.46	0.96	0.97	0.01	0.38	0.40	0.71 (0.01)
	ASF_fruits_veg	0.93	0.45	0.80	0.16	0.05	0.21	0.69 (0.02)
	dairy_fruits_veg	0.61	0.90	0.94	0.03	0.28	0.31	0.75 (0.01)

Table 14. Sensitivity/specificity analysis of the relationship between intake of sentinel food groups and combinations of groups (1-gram minimum) and Mean Micronutrient Density Adequacy (MMDA-no iron) ≥ 75%, where sum of sensitivity and specificity ≥ 1.25: Non-breastfed infants and children

	Food group	Sensitivity	Specificity	Positive predictive value	Proportion of false positives	Proportion of false negatives	Total proportion misclassified	Area under the curve (SE)
<u>Africa</u>								
Madagascar								
6-11 mo	Animal-source foods	0.91	0.43	0.56	0.32	0.04	0.36	0.67 (0.11)
	Dairy	0.82	0.79	0.75	0.12	0.08	0.20	0.80 (0.09)
	dairy_fruits_veg	0.64	0.86	0.78	0.08	0.16	0.24	0.75 (0.10)
12-23 mo	Dairy	0.39	0.90	0.77	0.05	0.29	0.34	0.64 (0.04)
	dairy_fruits_veg	0.38	0.91	0.79	0.05	0.29	0.34	0.64 (0.04)
<u>Latin America</u>								
Brazil								
12-23 mo	dairy_fruits_veg	0.97	0.32	0.82	0.16	0.03	0.19	0.64 (0.08)
Peru (Trujillo) [a]								
12-23 mo	Dairy	0.94	0.73	0.98	0.02	0.06	0.08	0.84 (0.05)
	Vitamin A-rich fruits and vegetables	0.73	0.57	0.95	0.03	0.25	0.28	0.65 (0.05)
	ASF_vitA	0.72	0.60	0.95	0.03	0.25	0.28	0.66 (0.05)
	Dairy_vitA	0.68	0.90	0.99	0.01	0.29	0.30	0.79 (0.04)
	ASF_fruits_veg	0.92	0.33	0.94	0.05	0.07	0.13	0.63 (0.06)
	dairy_fruits_veg	0.87	0.80	0.98	0.02	0.12	0.14	0.83 (0.04)

[a] In Peru – Trujillo, results are not reported for non-breasted children 6-11 mo, because only 2 children had MMDA-no iron < 75%.

Table 15. Area under the curve (AUC) for sentinel food groups and combinations of groups when mean micronutrient density adequacy (MMDA-no iron) cutoff is 75% and where sum of sensitivity and specificity ≥ 1.25: Breastfed infants and children[a]

		Animal-source foods	Dairy	Vitamin A-rich fruits and vegetables	Other fruits and vegetables	Animal-source foods-vitamin A-rich fruits and vegetables	Dairy-Vitamin A-rich fruits and vegetables	Animal-source foods-ANY fruits and vegetables	Dairy-ANY fruits and vegetables
<u>Africa</u>									
Ghana									
6-11 mo	AUC	0.67			0.76	0.74		0.74	
	SE	(0.03)			(0.03)	(0.04)		(0.04)	
Madagascar									
6-11 mo	AUC		0.64	0.62				0.65	0.66
	SE		(0.02)	(0.02)				(0.02)	(0.02)
12-23 mo	AUC	0.69	0.66					0.70	0.66
	SE	(0.02)	(0.02)					(0.02)	(0.02)
Malawi									
6-11 mo	AUC			0.84	0.56				
	SE			(0.03)	(0.05)				
12-23 mo	AUC	0.63		0.64	0.53	0.64		0.64	
	SE	(0.04)		(0.04)	(0.04)	(0.04)		(0.04)	
<u>Asia</u>									
Bangladesh									
6-11 mo	AUC	0.74	0.64	0.73	0.71	0.69	0.67	0.69	0.67
	SE	(0.08)	(0.09)	(0.09)	(0.08)	(0.10)	(0.10)	(0.10)	(0.10)
India									
12-23 mo	AUC	0.62	0.62					0.69	0.69
	SE	(0.02)	(0.02)					(0.02)	(0.02)
Philippines (all)									
6-11 mo	AUC	0.73	0.78		0.64			0.67	0.67
	SE	(0.02)	(0.02)		(0.02)			(0.03)	(0.03)
Philippines (non-fortified)									
6-11 mo	AUC	0.71	0.68		0.74			0.74	0.73
	SE	(0.03)	(0.03)		(0.04)			(0.04)	(0.04)
Philippines (fortified)									
6-11 mo	AUC	0.70	0.72						
	SE	(0.05)	(0.05)						

(continued)

<u>**Latin America**</u>									
Honduras									
6-8 mo						0.66		0.65	
						(0.02)		(0.02)	
Peru (Huascar)									
6-11 mo	AUC	0.64		0.65		0.65		0.68	
	SE	(0.02)		(0.02)		(0.02)		(0.02)	
Peru (Trujillo)									
6-11 mo	AUC	0.73	0.70	0.68		0.75	0.67	0.76	0.70
	SE	0.02	(0.02)	(0.02)		(0.02)	(0.02)	(0.02)	(0.01)
12-23 mo	AUC	0.66	0.77	0.63		0.70	0.71	0.69	0.75
	SE	(0.02)	(0.01)	(0.02)		(0.02)	(0.01)	(0.02)	(0.01)

[a] Standard error in parentheses.

Table 16. Area under the curve (AUC) for sentinel food groups and combinations of groups when Mean Micronutrient Density Adequacy (MMDA-no iron) cutoff is 75% and where sum of sensitivity and specificity ≥ 1.25: Non-breastfed infants and children[a]

		Animal-source foods	Dairy	Vitamin A-rich fruits and vegetables	Other fruits and vegetables	Animal-source foods-vitamin A-rich fruits and vegetables	Dairy-Vitamin A-rich fruits and vegetables	Animal-source foods-ANY fruits and vegetables	Dairy-ANY fruits and vegetables
<u>Africa</u>									
Madagascar									
6-11 mo	AUC	0.67	0.80						0.75
	SE	(0.11)	(0.09)						(0.100
12-23 mo	AUC		0.64						0.64
	SE		(0.04)						(0.04)
<u>Latin America</u>									
Brazil									
12-23 mo	AUC								0.64
	SE								(0.08)
Peru (Trujillo)									
6-11 mo[b]									
12-23 mo	AUC		0.84	0.65		0.66	0.79	0.63	0.83
	SE		(0.05)	(0.05)		(0.05)	(0.04)	(0.06)	(0.04)

[a] Standard error in parentheses.

[b] In Peru – Trujillo, results are not reported for non-breasted children 6-11 mo, because only 2 children had MMDA-no iron < 75%.

Table 17. Energy intake per feed from dairy products, by country, dairy product, and age, for non-breastfed infants and children

(number of feeds)	India (1,189)		Brazil (315)		Peru (Trujillo)[a] (2,161)	
	Median (I-Q range)		Median (I-Q range)		Median (I-Q range)	
Milk (kcal)	79	(50-119)	150	(125-163)	122	(100-156)
Yogurt (kcal)	42	(30-54)	n/a	n/a	n/a	n/a
Infant formula	n/a	n/a	n/a	n/a	102	(80-121)
All (kcal)	77	(50-117)	150	(125-163)	120	(98-156)
6-11.9 mo (kcal)	n/a	n/a	n/a	n/a	111	(79-137)
12-17.9 mo (kcal)	74	(50-99)	145	(124-155)	130	(104-156)
18-23.9 mo (kcal)	80	(50-124)	150	(131-165)	n/a	n/a

[a] The data file available from Peru was aggregated to the level of the child-day; information was not available at the level of the feed. Therefore mean kcal per feed was calculated by dividing the total kcal per day by the number of feeds. The median reported in this table for Peru is the median value, across child-days, for this calculated mean.

Table 18. Variability in energy intake per day from dairy products, and percent below illustrative cutoffs, among non-breastfed infants and children receiving dairy products[a]

(number of child days)	India (319)		Brazil (76)		Peru (Trujillo) (476)	
	Median	I-Q range	Median	I-Q range	Median	I-Q range
Dairy products (kcal/d)	260	(175-428)	529	(400-698)	536	(371-700)
			Percent of children below cutoff			
< 300 kcal/d	60		12		13	
< 400 kcal/d	72		25		28	

[a] This tables reports energy intakes from milk, yogurt, and formula taken together. Results for milk alone were very similar.

FIGURES

Figure 1. MMDA-no iron by FGI7: Breastfed infants 6-8 months

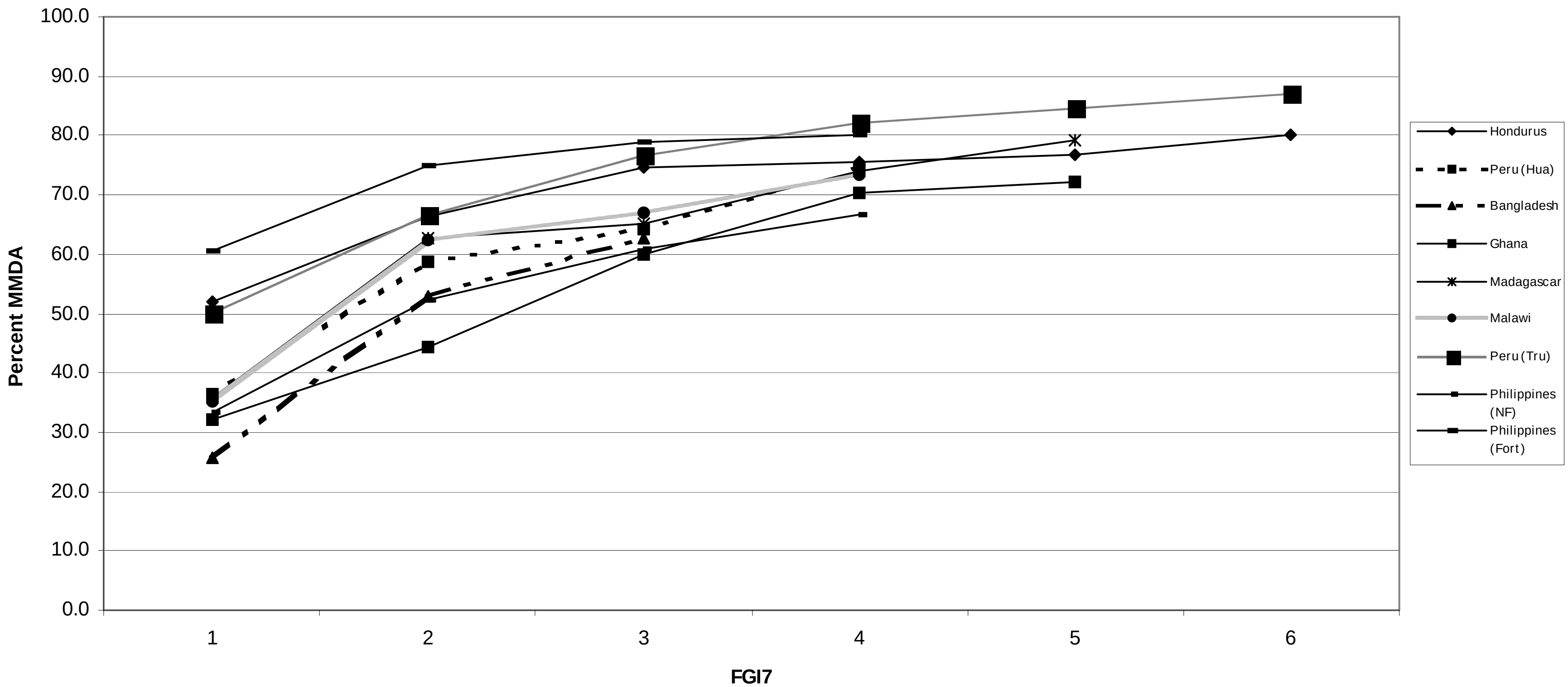


Figure 2. MMDA-no iron by FGI7: Breastfed infants 9-11 months

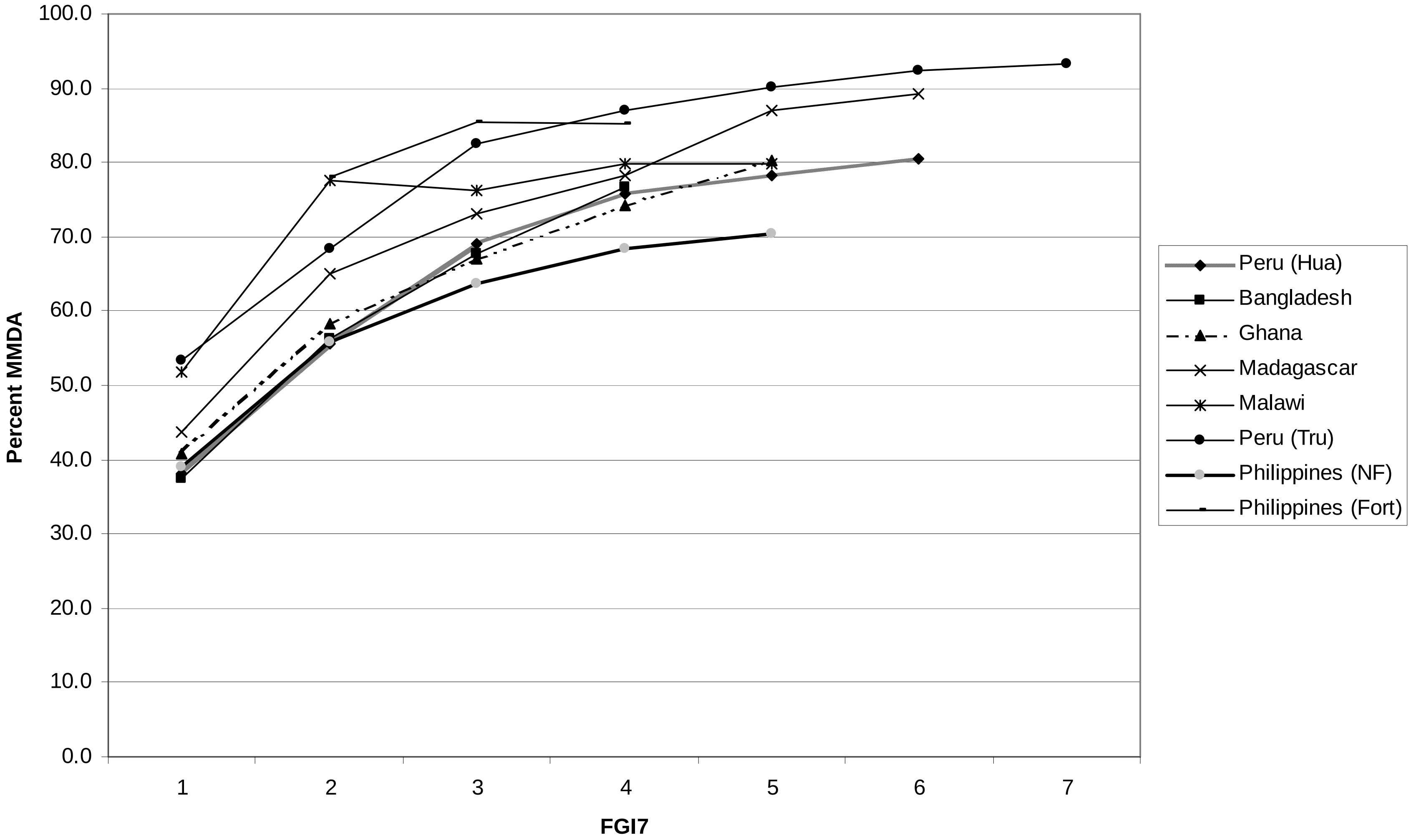


Figure 3. MMDA-no iron by FGI7: Breastfed children 12-23 months

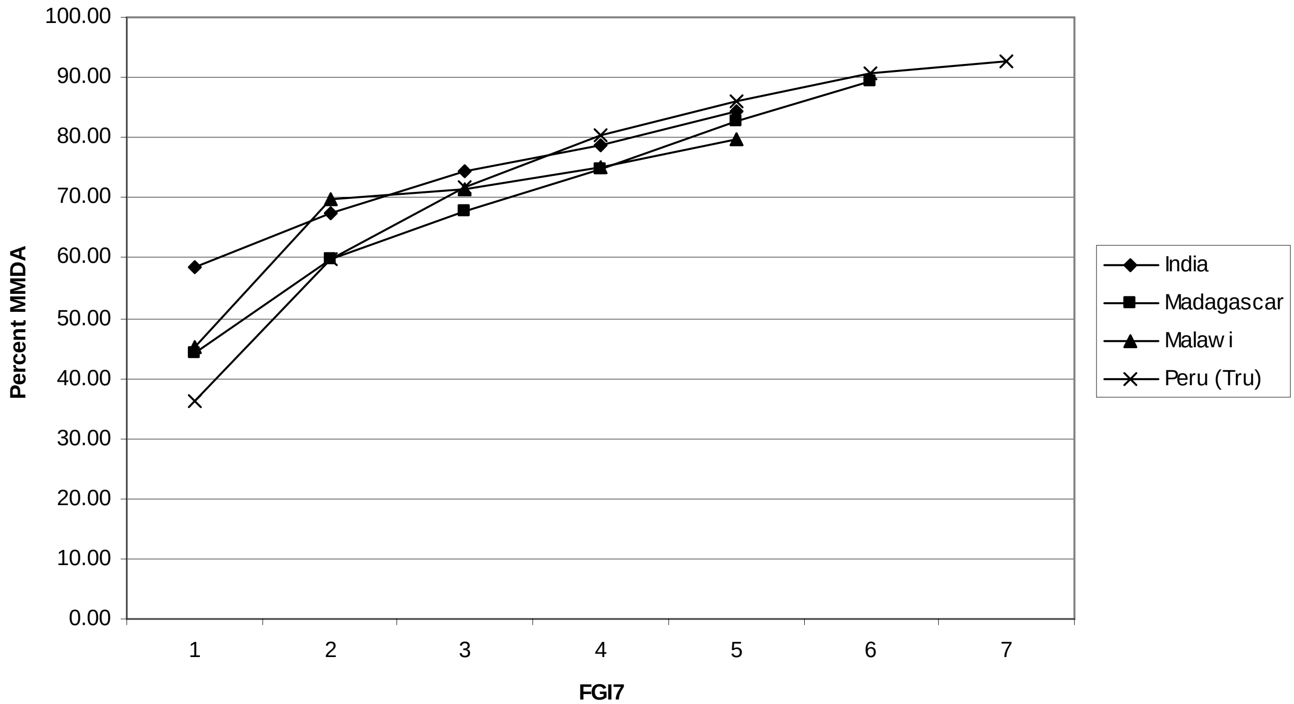


Figure 4. MMDA-no iron by FGI7: Non-breastfed infants 6-8 months

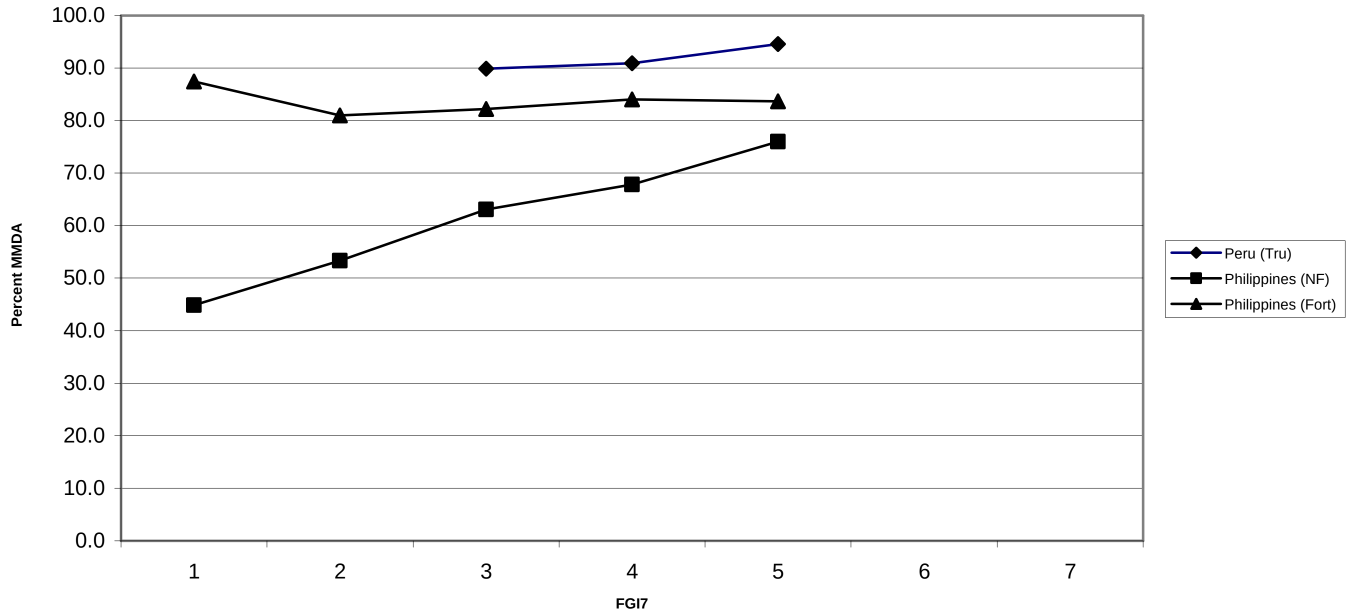


Figure 5. MMDA-no iron by FGI7: Non-breastfed infants 9-11 months

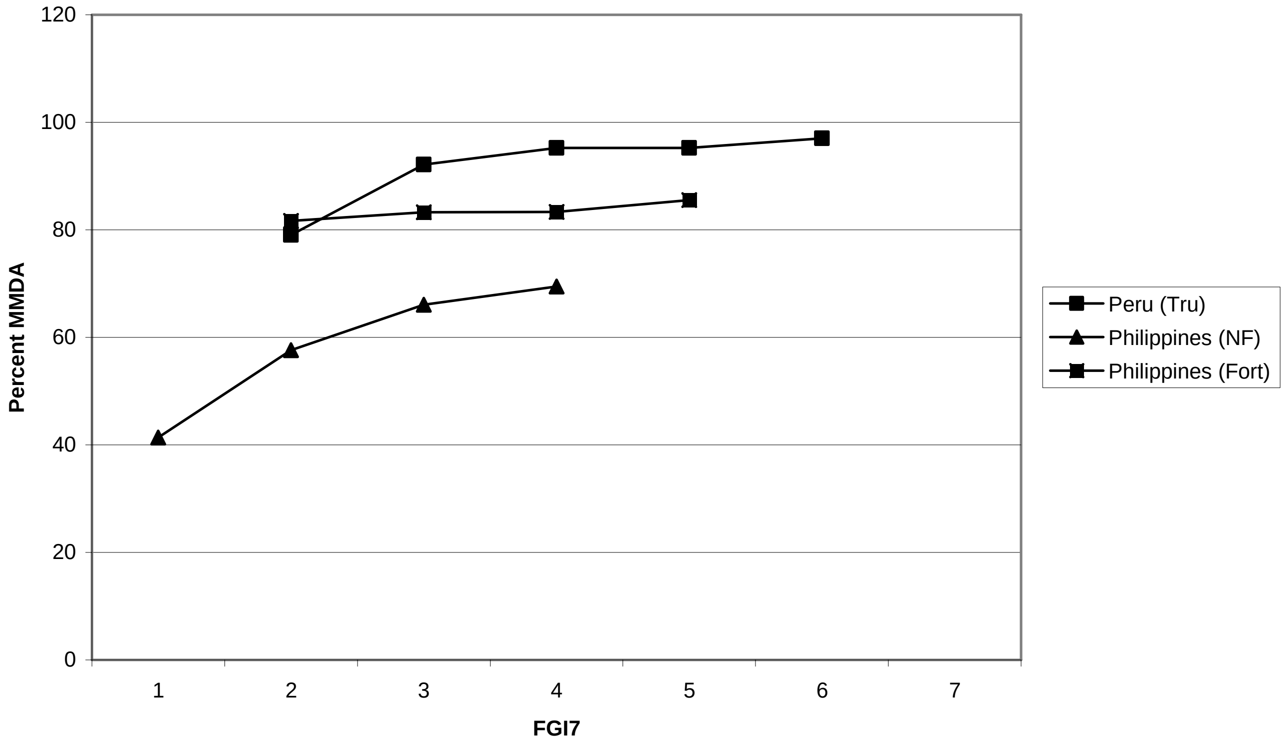


Figure 6. MMDA-no iron by FGI7: Non-breastfed children 12-23 months

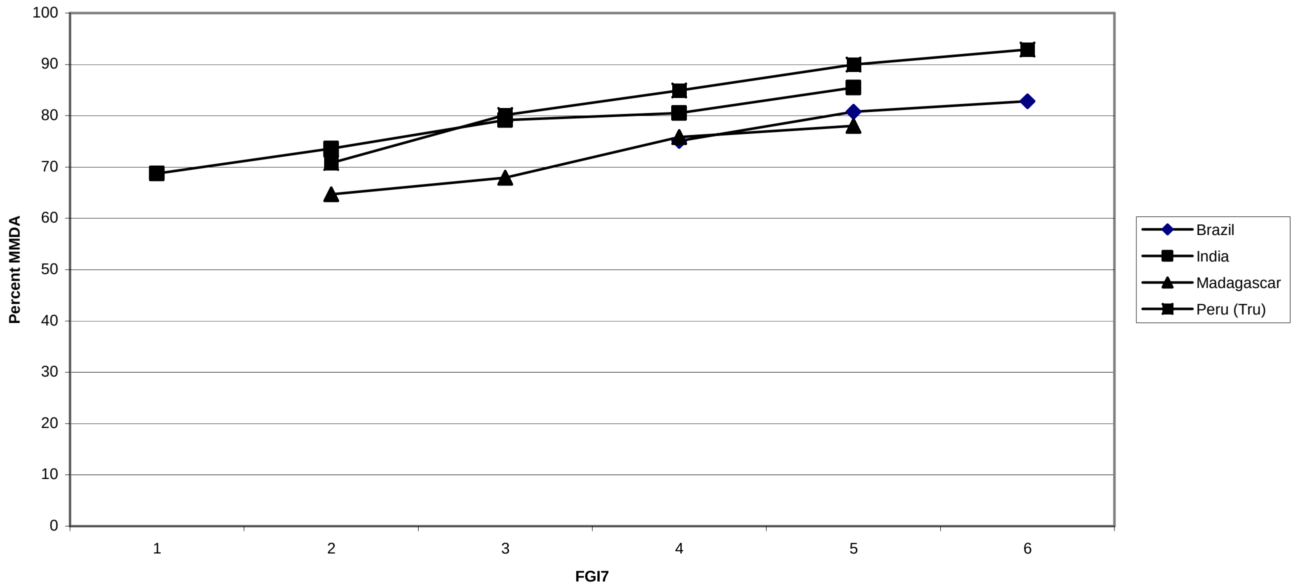
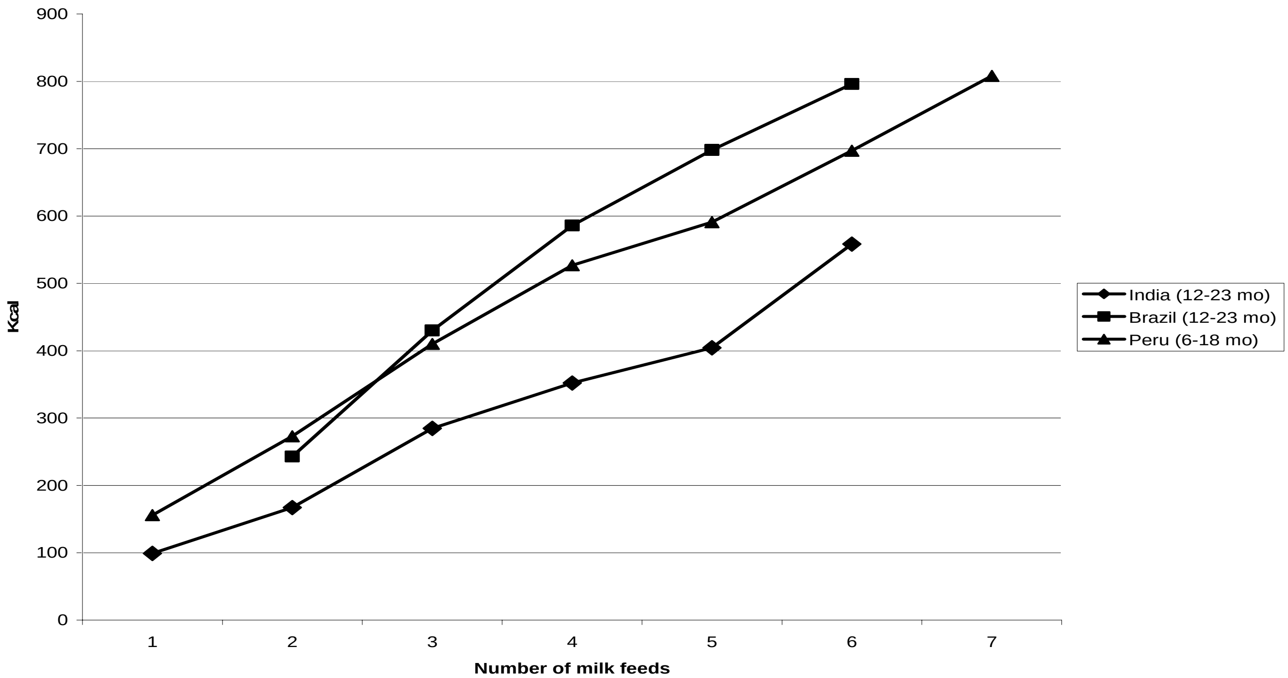


Figure 7. Median energy intake from milk per child-day, by number of feeds for non-breastfed children[a]



[a] Sample sizes at 1, 2, 3, 4, 5, and 6 feeds are 36, 75, 80, 67, 26, and 15 for India; 1, 7, 24, 17, 15, and 6 for Brazil; and 13, 33, 96, 97, 77, and 66 for Peru, respectively. In Peru, 7 feeds were reported for 28 child-days. In India, 7-8 feeds were reported on 3% of child-days; in Brazil, 7-10 feeds were reported on 8% of child-days; in Peru, 8-12 feeds were reported on 7% of child-days.

APPENDIX: RESULTS for FGI8

Table A1. Association (correlation coefficient) between Mean Micronutrient Density Adequacy (MMDA-no iron) and dietary diversity (FGI8), by country, age group, and breastfeeding status [a]

	Breastfed children			Non-breastfed children		
Countries	**6–8 mo**	**9–11 mo**	**12–23 mo**	**6–8 mo**	**9–11 mo**	**12–23 mo**
Africa						
Ghana	0.72	0.49	–	–	–	–
Madagascar	0.48	0.50	0.49			0.38[b]
Malawi	0.59	0.24	0.32	–	–	–
Asia						
Bangladesh	0.73	0.69	–	–	–	–
India	–	–	0.31	–	–	0.25
Philippines	0.63	0.65	–	0.24	0.31	–
No fortified foods	0.67	0.66	–	0.54	0.47	–
Fortified foods	0.50	0.20[c]	–	0.04[c]	0.07 [c]	–
Latin America						
Brazil	–	–	–	–	–	0.27
Honduras	0.48	–	–	–	–	–
Peru (Huascar)	0.56	0.45	–	–	–	–
Peru (Trujillo)	0.57	0.64	0.64	0.33	0.41	0.46

[a] All correlations are significant ($p < 0.05$), except where noted.

[b] Result for all children 6 – 23 mo; n for < 12 mo = 25 and n for ≥ 12 mo = 184.

[c] Correlation not significant ($p > 0.05$).

Table A2. Area under the curve (AUC) for FGI8 when Mean Micronutrient Density Adequacy (MMDA-no iron) cutoff is 75%

	Breastfed children				**Non-breastfed children**			
	6–8 mo	**9–11 mo**	**6–11 mo**	**12–23 mo**	**6–8 mo**	**9–11 mo**	**6–11 mo**	**12–23 mo**
Africa								
Ghana	0.87*** (0.03)	0.79*** (0.04)	0.84*** (0.02)	–	–	–	–	–
Madagascar	0.67*** (0.03)	0.70*** (0.03)	0.70*** (0.02)	0.71*** (0.02)	–	–	–	0.62** (0.04)[b]
Malawi	0.71** *(0.06)*	0.64* *(0.06)*	0.70*** *(0.04)*	0.61** *(0.04)*	–	–	–	–
Asia								
Bangladesh	–[c]	0.88*** (0.05)	0.91*** (0.03)	–	–	–	–	–
India	–	–	0.63*** *(0.02)*		–	–	–	0.58* *(0.03)*
Philippines	*0.77*** (0.02)*	*0.76*** (0.03)*	0.76*** (0.02)	–	0.57*** (0.02)	0.63*** (0.02)	0.59*** (0.02)	–
No fortified foods	0.78*** (0.04)	0.76*** (0.04)	0.77*** (0.03)	–	0.79*** (0.04)	0.75*** (0.03)	0.76*** (0.02)	–
Fortified foods	–[d]	[d]	0.77*** (0.04)		0.56 (0.04)	0.59 (0.05)	0.57* (0.03)	
Latin America								
Brazil	–	–	–	–	–	–	–	0.69* (0.07)
Honduras	0.66*** (0.02)	–		–	–	–	–	–
Peru (Huascar)	0.70*** (0.03)	0.66*** (0.03)	0.69*** (0.02)	–	–	–	–	–
Peru (Trujillo)	0.80*** *(0.02)*	0.88*** *(0.02)*	0.82*** *(0.01)*	0.81*** *(0.01)*	–[e]	[e]	[e]	0.79*** *(0.04)*

* Significant at p ≤ 0.05.

** Significant at p ≤ 0.01.

*** Significant at p ≤ 0.001.

– –

[a] Standard error in parentheses.

[b] Result for all children 6 – 23 mo; n for < 12 mo = 25 and n for ≥ 12 mo = 184.

[c] In Bangladesh (breastfed children 6-8 mo) and in Peru - Trujillo (non-breastfed children 6-8 mo and 9-11 mo), this analysis is not reported because there were too few children (< 5) with MMDA-no iron below 75%.

[d] Result for 6-11 mo because there are not enough children in each age subgroup.

Table A3. Micronutrient density adequacy: P-values from test comparing area under the curve for FGI7 and FGI8, at MMDA-no iron cutoff of 75%

	Breastfed children			Non-breastfed children		
Countries	**6–8 mo**	**9–11 mo**	**12–23 mo**	**6–8 mo**	**9–11 mo**	**12–23 mo**
Africa						
Ghana	0.27	0.94	–	–	–	–
Madagascar	0.02[a]	0.00[a]	0.01[a]			0.00[a . b]
Malawi	0.03[a]	0.02[a]	0.06	–	–	–
Asia						
Bangladesh	0.36	0.16	–	–	–	–
India	–	–	0.00[a]	–	–	0.28
Philippines	0.05[a]	0.00 [a]	–	0.79	0.03[a]	–
No fortified foods	0.00[a]	0.00 [a]	–	0.00[a]	0.09	–
Fortified foods	0.99[c]		–	0.74	0.67	–
Latin America						
Brazil	–	–	–	–	–	0.02[a]
Honduras	0.01	–	–	–	–	–
Peru (Huascar)	0.01[a]	0.00[a]	–	–	–	–
Peru (Trujillo)	0.26	0.94	0.25	0.34[c]		0.83

[a] AUC of FGI7 is greater than AUC of FGI8.

[b] Result for all children 6 – 23 mo; n for < 12 mo = 25 and n for ≥ 12 mo = 184.

[c] Results for 6 - 11 mo, not enough children in age subgroups.

Table A4. Sensitivity/specificity analysis of the relationship between food group diversity (FGI8) and Mean Micronutrient Density Adequacy (using MMDA-no iron ≥ 75% cutoff point), by FGI8 cutoff for breastfed infants 6-11 mo

Cutoffs	Sensitivity	Specificity	Positive predictive value	Proportion of false positives	Proportion of false negatives	Total proportion misclassified
Africa						
Ghana						
≥ 1	1.00	0.00	0.18	0.82	0.00	0.82
≥ 2	1.00	0.10	0.19	0.74	0.00	0.74
≥ 3	0.97	0.53	0.31	0.39	0.01	0.39
≥ 4	0.76	0.79	0.44	0.17	0.04	0.21
≥ 5	0.40	0.91	0.49	0.07	0.11	0.18
≥ 6	0.16	0.98	0.61	0.02	0.15	0.17
≥ 7	0.01	1.00	0.50	0.00	0.18	0.18
≥ 8						
Madagascar						
≥ 1	1.00	0.03	0.39	0.59	0.00	0.59
≥ 2	0.99	0.17	0.43	0.51	0.00	0.51
≥ 3	0.89	0.36	0.46	0.39	0.04	0.44
≥ 4	0.67	0.63	0.54	0.23	0.13	0.35
≥ 5	0.33	0.86	0.60	0.09	0.26	0.34
≥ 6	0.09	0.98	0.76	0.01	0.35	0.36
≥ 7	0.01	1.00	0.80	0.00	0.38	0.38
≥ 8	0.00	1.00	-	0.00	0.39	0.39
Malawi						
≥ 1	1.00	0.00	0.49	0.51	0.00	0.51
≥ 2	1.00	0.36	0.60	0.32	0.00	0.32
≥ 3	0.76	0.49	0.59	0.26	0.12	0.38
≥ 4	0.45	0.76	0.65	0.12	0.27	0.39
≥ 5	0.18	0.91	0.67	0.04	0.41	0.45
≥ 6	0.09	0.99	0.88	0.01	0.45	0.46
≥ 7	0.04	1.00	1.00	0.00	0.47	0.47
≥ 8	0.00	1.00	-	0.00	0.49	0.49
Asia						
Bangladesh						
≥ 1	1.00	0.00	0.10	0.90	0.00	0.90
≥ 2	1.00	0.46	0.18	0.48	0.00	0.48
≥ 3	0.92	0.84	0.39	0.15	0.01	0.16
≥ 4	0.33	0.96	0.50	0.03	0.07	0.10
≥ 5	0.08	1.00	1.00	0.00	0.09	0.09
≥ 6						
≥ 7						
≥ 8						
Philippines						
All child-days (w/ and w/o fortified products						
≥ 1	1.00	0.00	0.13	0.87	0.00	0.87
≥ 2	0.96	0.39	0.19	0.53	0.01	0.53
≥ 3	0.65	0.73	0.27	0.23	0.05	0.28
≥ 4	0.29	0.93	0.39	0.06	0.09	0.15
≥ 5	0.06	0.98	0.32	0.02	0.12	0.14
≥ 6	0.01	1.00	0.40	0.00	0.13	0.13
≥ 7	0.00	1.00	-	0.00	0.13	0.13
≥ 8	0.00	1.00	-	0.00	0.13	0.13

(continued)

Cutoffs	Sensitivity	Specificity	Positive predictive value	Proportion of false positives	Proportion of false negatives	Total proportion misclassified
Non-fortified						
≥ 1	1.00	0.02	0.06	0.92	0.00	0.92
≥ 2	0.96	0.39	0.09	0.57	0.00	0.57
≥ 3	0.68	0.73	0.14	0.25	0.02	0.27
≥ 4	0.32	0.93	0.22	0.07	0.04	0.11
≥ 5	0.06	0.98	0.17	0.02	0.06	0.07
≥ 6	0.01	1.00	0.25	0.00	0.06	0.06
≥ 7	0.00	1.00	-	0.00	0.06	0.06
≥ 8	0.00	1.00	-	0.00	0.06	0.06
Fortified						
≥ 1	1.00	0.00	0.63	0.37	0.00	0.37
≥ 2	0.96	0.36	0.72	0.24	0.02	0.26
≥ 3	0.63	0.77	0.82	0.09	0.23	0.32
≥ 4	0.27	0.95	0.90	0.02	0.45	0.47
≥ 5	0.06	0.98	0.86	0.01	0.59	0.60
≥ 6	0.01	1.00	1.00	0.00	0.62	0.62
≥ 7	0.00	1.00	-	0.00	0.63	0.63
≥ 8	0.00	1.00	-	0.00	0.63	0.63
Latin America						
Peru (Huascar)						
≥ 1	1.00	0.00	0.36	0.64	0.00	0.64
≥ 2	0.99	0.19	0.41	0.51	0.00	0.52
≥ 3	0.88	0.38	0.45	0.40	0.04	0.44
≥ 4	0.65	0.64	0.51	0.23	0.13	0.36
≥ 5	0.27	0.87	0.53	0.09	0.27	0.35
≥ 6	0.11	0.98	0.71	0.02	0.33	0.34
≥ 7	0.02	1.00	1.00	0.00	0.36	0.36
≥ 8						
Peru (Trujillo)						
≥ 1	1.00	0.00	0.75	0.25	0.00	0.25
≥ 2	1.00	0.16	0.78	0.21	0.00	0.21
≥ 3	0.94	0.46	0.84	0.13	0.04	0.18
≥ 4	0.75	0.77	0.91	0.06	0.19	0.24
≥ 5	0.44	0.92	0.94	0.02	0.42	0.44
≥ 6	0.17	0.99	0.97	0.00	0.62	0.63
≥ 7	0.03	1.00	0.97	0.00	0.73	0.73
≥ 8	0.00	1.00	1.00	0.00	0.75	0.75

Table A5. Sensitivity/specificity analysis of the relationship between food group diversity (FGI8) and Mean Micronutrient Density Adequacy (using MMDA-no iron ≥ 75% cutoff point), by FGI8 cutoff for breastfed infants 6-8 mo

Cutoffs	Sensitivity	Specificity	Positive predictive value	Proportion of false positives	Proportion of false negatives	Total proportion misclassified
Africa						
Ghana						
≥ 1	1.00	0.00	0.09	0.91	0.00	0.91
≥ 2	1.00	0.14	0.10	0.78	0.00	0.78
≥ 3	1.00	0.61	0.20	0.36	0.00	0.36
≥ 4	0.68	0.87	0.35	0.11	0.03	0.14
≥ 5	0.26	0.94	0.31	0.05	0.07	0.12
≥ 6	0.11	0.98	0.40	0.01	0.08	0.10
≥ 7	0.00	0.99	0.00	0.00	0.09	0.10
≥ 8						
Madagascar						
≥ 1	1.00	0.05	0.31	0.67	0.00	0.67
≥ 2	0.98	0.20	0.35	0.56	0.01	0.56
≥ 3	0.78	0.41	0.36	0.41	0.07	0.48
≥ 4	0.57	0.69	0.44	0.22	0.13	0.34
≥ 5	0.21	0.90	0.48	0.07	0.24	0.31
≥ 6	0.03	0.99	0.50	0.01	0.29	0.30
≥ 7	0.00	1.00	0.00	0.00	0.30	0.30
≥ 8	0.00	1.00	-	0.00	0.30	0.30
Malawi						
≥ 1	1.00	0.00	0.30	0.70	0.00	0.70
≥ 2	1.00	0.46	0.44	0.38	0.00	0.38
≥ 3	0.75	0.57	0.43	0.30	0.08	0.38
≥ 4	0.35	0.80	0.44	0.14	0.20	0.33
≥ 5	0.05	0.93	0.25	0.05	0.29	0.33
≥ 6	0.05	1.00	1.00	0.00	0.29	0.29
≥ 7	0.05	1.00	1.00	0.00	0.29	0.29
≥ 8	0.00	1.00	-	0.00	0.30	0.30
Asia						
Bangladesh						
≥ 1	1.00	0.00	0.06	0.94	0.00	0.94
≥ 2	1.00	0.59	0.14	0.39	0.00	0.39
≥ 3	1.00	0.89	0.38	0.10	0.00	0.10
≥ 4	0.33	0.98	0.50	0.02	0.04	0.06
Philippines						
All child-days (w/ and w/o fortified products)						
≥ 1	1.00	0.00	0.14	0.86	0.00	0.86
≥ 2	0.96	0.43	0.21	0.49	0.01	0.50
≥ 3	0.61	0.78	0.31	0.19	0.05	0.25
≥ 4	0.26	0.93	0.37	0.06	0.10	0.16
≥ 5	0.04	0.98	0.24	0.02	0.13	0.15
≥ 6	0.01	1.00	0.33	0.00	0.14	0.14
≥ 7	0.00	1.00	-	0.00	0.14	0.14
≥ 8	0.00	1.00	-	0.00	0.14	0.14

(continued)

Cutoffs	Sensitivity	Specificity	Positive predictive value	Proportion of false positives	Proportion of false negatives	Total proportion misclassified
Non-fortified						
≥ 1	1.00	0.00	0.06	0.94	0.00	0.94
≥ 2	0.94	0.43	0.09	0.53	0.00	0.54
≥ 3	0.67	0.78	0.15	0.21	0.02	0.23
≥ 4	0.27	0.93	0.18	0.07	0.04	0.11
≥ 5	0.06	0.98	0.14	0.02	0.05	0.07
≥ 6	0.03	1.00	0.33	0.00	0.05	0.06
≥ 7	0.00	1.00	-	0.00	0.06	0.06
≥ 8	0.00	1.00	-	0.00	0.06	0.06
Fortified						
≥ 1	1.00	0.00	0.55	0.45	0.00	0.45
≥ 2	0.97	0.41	0.66	0.27	0.02	0.29
≥ 3	0.58	0.76	0.75	0.11	0.23	0.34
≥ 4	0.25	0.96	0.89	0.02	0.41	0.43
≥ 5	0.03	0.98	0.67	0.01	0.53	0.54
≥ 6	0.00	1.00	-	0.00	0.55	0.55
≥ 7	0.00	1.00	-	0.00	0.55	0.55
≥ 8	0.00	1.00	-	0.00	0.55	0.55
<u>Latin America</u>						
Honduras						
≥ 1	1.00	0.00	0.47	0.53	0.00	0.53
≥ 2	0.97	0.16	0.50	0.45	0.01	0.46
≥ 3	0.83	0.44	0.57	0.30	0.08	0.38
≥ 4	0.56	0.66	0.59	0.18	0.21	0.39
≥ 5	0.28	0.84	0.60	0.09	0.34	0.42
≥ 6	0.10	0.94	0.60	0.03	0.42	0.45
≥ 7	0.02	0.99	0.67	0.00	0.46	0.46
≥ 8	0.01	1.00	0.67	0.00	0.47	0.47
Peru (Huascar)						
≥ 1	1.00	0.00	0.31	0.69	0.00	0.69
≥ 2	0.98	0.02	0.38	0.51	0.01	0.52
≥ 3	0.80	0.20	0.39	0.39	0.06	0.46
≥ 4	0.61	0.39	0.50	0.19	0.12	0.32
≥ 5	0.19	0.81	0.56	0.05	0.25	0.30
≥ 6	0.03	1.00	0.75	0.00	0.31	0.31
≥ 7						
≥ 8						
Peru (Trujillo)						
≥ 1	1.00	0.00	0.72	0.28	0.00	0.28
≥ 2	1.00	0.15	0.75	0.24	0.00	0.24
≥ 3	0.93	0.41	0.80	0.16	0.05	0.21
≥ 4	0.75	0.75	0.88	0.07	0.18	0.25
≥ 5	0.43	0.90	0.92	0.03	0.41	0.44
≥ 6	0.15	0.98	0.95	0.01	0.61	0.62
≥ 7	0.02	1.00	0.94	0.00	0.71	0.71
≥ 8	0.00	1.00	1.00	0.00	0.72	0.72

Table A6. Sensitivity/specificity analysis of the relationship between food group diversity (FGI8) and Mean Micronutrient Density Adequacy (using MMDA-no iron ≥ 75% cutoff point), by FGI8 cutoff for breastfed infants 9-11 mo

Cutoffs	Sensitivity	Specificity	Positive predictive value	Proportion of false positives	Proportion of false negatives	Total proportion misclassified
Africa						
Ghana						
≥ 1	1.00	0.00	0.28	0.72	0.00	0.72
≥ 2	1.00	0.03	0.29	0.69	0.00	0.69
≥ 3	0.96	0.41	0.39	0.42	0.01	0.43
≥ 4	0.80	0.67	0.49	0.24	0.06	0.30
≥ 5	0.45	0.86	0.56	0.10	0.16	0.26
≥ 6	0.18	0.97	0.69	0.02	0.23	0.26
≥ 7	0.02	1.00	1.00	0.00	0.28	0.28
≥ 8						
Madagascar						
≥ 1	1.00	0.01	0.49	0.50	0.00	0.50
≥ 2	1.00	0.11	0.52	0.45	0.00	0.45
≥ 3	0.97	0.27	0.56	0.37	0.02	0.39
≥ 4	0.75	0.54	0.61	0.24	0.12	0.36
≥ 5	0.43	0.79	0.66	0.11	0.28	0.39
≥ 6	0.14	0.97	0.84	0.01	0.42	0.44
≥ 7	0.03	1.00	1.00	0.00	0.48	0.48
≥ 8	0.00	1.00	-	0.00	0.49	0.49
Malawi						
≥ 1	1.00	0.00	0.63	0.37	0.00	0.37
≥ 2	1.00	0.24	0.69	0.28	0.00	0.28
≥ 3	0.76	0.38	0.68	0.23	0.15	0.38
≥ 4	0.48	0.71	0.74	0.11	0.33	0.43
≥ 5	0.22	0.88	0.76	0.04	0.49	0.53
≥ 6	0.10	0.97	0.86	0.01	0.57	0.58
≥ 7	0.03	1.00	1.00	0.00	0.61	0.61
≥ 8	0.00	1.00	-	0.00	0.63	0.63
Asia						
Bangladesh						
≥ 1	1.00	0.00	0.13	0.87	0.00	0.87
≥ 2	1.00	0.36	0.20	0.55	0.00	0.55
≥ 3	0.89	0.79	0.40	0.18	0.01	0.19
≥ 4	0.33	0.95	0.50	0.04	0.09	0.13
≥ 5	0.11	1.00	1.00	0.00	0.12	0.12
Philippines						
All child-days (w/ and w/o fortified products)						
≥ 1	1.00	0.00	0.12	0.88	0.00	0.88
≥ 2	0.96	0.35	0.17	0.57	0.01	0.58
≥ 3	0.69	0.68	0.24	0.28	0.04	0.31
≥ 4	0.35	0.93	0.40	0.06	0.08	0.14
≥ 5	0.08	0.98	0.43	0.01	0.11	0.13
≥ 6	0.01	1.00	0.50	0.00	0.12	0.12
≥ 7	0.00	1.00	-	0.00	0.12	0.12
≥ 8	0.00	1.00	-	0.00	0.12	0.12

(continued)

Cutoffs	Sensitivity	Specificity	Positive predictive value	Proportion of false positives	Proportion of false negatives	Total proportion misclassified
Non-fortified						
≥ 1	1.00	0.00	0.07	0.93	0.00	0.93
≥ 2	0.97	0.35	0.09	0.61	0.00	0.61
≥ 3	0.69	0.68	0.13	0.30	0.02	0.32
≥ 4	0.37	0.93	0.27	0.07	0.04	0.11
≥ 5	0.06	0.98	0.20	0.01	0.06	0.08
≥ 6	0.00	1.00	0.00	0.00	0.07	0.07
≥ 7	0.00	1.00	-	0.00	0.07	0.07
≥ 8	0.00	1.00	-	0.00	0.07	0.07
Fortified						
≥ 1	1.00	0.00	0.84	0.16	0.00	0.16
≥ 2	0.95	0.00	0.83	0.16	0.05	0.20
≥ 3	0.70	0.86	0.96	0.02	0.25	0.27
≥ 4	0.32	0.86	0.92	0.02	0.57	0.59
≥ 5	0.11	1.00	1.00	0.00	0.75	0.75
≥ 6	0.03	1.00	1.00	0.00	0.82	0.82
≥ 7	0.00	1.00	-	0.00	0.84	0.84
≥ 8	0.00	1.00	-	0.00	0.84	0.84
Latin America						
Peru (Huascar)						
≥ 1	1.00	0.00	0.43	0.57	0.00	0.57
≥ 2	1.00	0.10	0.45	0.52	0.00	0.52
≥ 3	0.95	0.30	0.50	0.40	0.02	0.42
≥ 4	0.68	0.53	0.52	0.27	0.14	0.40
≥ 5	0.34	0.77	0.52	0.13	0.28	0.42
≥ 6	0.17	0.95	0.70	0.03	0.35	0.38
≥ 7	0.05	1.00	1.00	0.00	0.41	0.41
≥ 8						
Peru (Trujillo)						
≥ 1	1.00	0.00	0.81	0.19	0.00	0.19
≥ 2	1.00	0.20	0.84	0.16	0.00	0.16
≥ 3	0.95	0.59	0.91	0.08	0.04	0.12
≥ 4	0.76	0.84	0.95	0.03	0.19	0.22
≥ 5	0.46	0.96	0.98	0.01	0.44	0.45
≥ 6	0.21	1.00	1.00	0.00	0.64	0.64
≥ 7	0.05	1.00	1.00	0.00	0.77	0.77
≥ 8	0.00	1.00	-	0.00	0.81	0.81

Table A7. Sensitivity/specificity analysis of the relationship between food group diversity (FGI8) and Mean Micronutrient Density Adequacy (using MMDA-no iron ≥ 75% cutoff point), by FGI8 cutoff for breastfed children 12-23 mo

Cutoffs	Sensitivity	Specificity	Positive predictive value	Proportion of false positives	Proportion of false negatives	Total proportion misclassified
Africa						
Madagascar						
≥ 1	1.00	0.00	0.41	0.58	0.00	0.58
≥ 2	1.00	0.04	0.42	0.56	0.00	0.56
≥ 3	0.96	0.14	0.44	0.50	0.02	0.52
≥ 4	0.84	0.43	0.51	0.34	0.07	0.40
≥ 5	0.56	0.75	0.61	0.15	0.18	0.33
≥ 6	0.23	0.94	0.74	0.03	0.32	0.35
≥ 7	0.05	0.99	0.82	0.00	0.39	0.40
≥ 8	0.00	1.00	0.50	0.00	0.41	0.41
Malawi						
≥ 1	1.00	0.00	0.48	0.53	0.00	0.53
≥ 2	1.00	0.08	0.50	0.48	0.00	0.48
≥ 3	0.86	0.28	0.52	0.38	0.07	0.45
≥ 4	0.62	0.55	0.55	0.24	0.18	0.42
≥ 5	0.23	0.83	0.55	0.09	0.37	0.45
≥ 6	0.09	0.96	0.67	0.02	0.43	0.45
≥ 7	0.00	1.00	-	0.00	0.48	0.48
≥ 8	0.00	1.00	-	0.00	0.48	0.48
Asia						
India						
≥ 1	1.00	0.00	0.52	0.48	0.00	0.48
≥ 2	0.95	0.10	0.53	0.43	0.03	0.46
≥ 3	0.77	0.34	0.55	0.32	0.12	0.44
≥ 4	0.59	0.63	0.63	0.18	0.21	0.39
≥ 5	0.32	0.85	0.69	0.07	0.35	0.43
≥ 6	0.03	0.99	0.83	0.00	0.50	0.50
≥ 7	0.00	1.00	1.00	0.00	0.52	0.52
≥ 8	0.00	1.00	-	0.00	0.52	0.52
Latin America						
Peru (Trujillo)						
≥ 1	1.00	0.00	0.71	0.29	0.00	0.29
≥ 2	1.00	0.05	0.72	0.28	0.00	0.28
≥ 3	0.98	0.24	0.76	0.22	0.01	0.23
≥ 4	0.89	0.54	0.83	0.13	0.08	0.21
≥ 5	0.65	0.82	0.90	0.05	0.25	0.30
≥ 6	0.32	0.97	0.96	0.01	0.48	0.49
≥ 7	0.08	1.00	1.00	0.00	0.66	0.66
≥ 8	0.00	1.00	1.00	0.00	0.71	0.71

Table A8. Sensitivity/specificity analysis of the relationship between food group diversity (FGI8) and Mean Micronutrient Density Adequacy (using MMDA-no iron ≥ 75% cutoff point), by FGI8 cutoff for non-breastfed infants 6-11 mo

Cutoffs	Sensitivity	Specificity	Positive predictive value	Proportion of false positives	Proportion of false negatives	Total proportion misclassified
Philippines						
All child-days (w/ and w/o fortified products						
≥ 1	1.00	0.00	0.34	0.66	0.00	0.66
≥ 2	0.97	0.05	0.35	0.63	0.01	0.64
≥ 3	0.58	0.57	0.41	0.28	0.14	0.43
≥ 4	0.26	0.86	0.49	0.09	0.25	0.34
≥ 5	0.09	0.96	0.55	0.02	0.31	0.33
≥ 6	0.03	0.99	0.68	0.00	0.33	0.34
≥ 7	0.00	1.00	0.50	0.00	0.34	0.34
≥ 8	0.00	1.00	-	0.00	0.34	0.34
Non-fortified						
≥ 1	1.00	0.01	0.11	0.88	0.00	0.88
≥ 2	1.00	0.06	0.12	0.84	0.00	0.84
≥ 3	0.87	0.56	0.20	0.39	0.01	0.41
≥ 4	0.48	0.85	0.29	0.13	0.06	0.19
≥ 5	0.17	0.96	0.37	0.03	0.09	0.13
≥ 6	0.05	0.99	0.45	0.01	0.11	0.11
≥ 7	0.01	1.00	0.50	0.00	0.11	0.11
≥ 8	0.00	1.00	-	0.00	0.11	0.11
Fortified						
≥ 1	1.00	0.00	0.74	0.26	0.00	0.26
≥ 2	0.96	0.01	0.74	0.25	0.03	0.28
≥ 3	0.50	0.63	0.80	0.09	0.37	0.46
≥ 4	0.21	0.91	0.87	0.02	0.59	0.61
≥ 5	0.07	0.97	0.86	0.01	0.69	0.70
≥ 6	0.02	1.00	1.00	0.00	0.73	0.73
≥ 7	0.00	1.00	-	0.00	0.74	0.74
≥ 8	0.00	1.00	-	0.00	0.74	0.74
Peru (Trujillo)						
≥ 1	1.00	0.00	0.98	0.02	0.00	0.02
≥ 2	0.98	0.00	0.98	0.02	0.02	0.04
≥ 3	0.94	0.50	0.99	0.01	0.06	0.07
≥ 4	0.84	0.50	0.99	0.01	0.15	0.16
≥ 5	0.48	1.00	1.00	0.00	0.51	0.51
≥ 6	0.19	1.00	1.00	0.00	0.79	0.79
≥ 7	0.07	1.00	1.00	0.00	0.91	0.91
≥ 8	0.01	1.00	1.00	0.00	0.97	0.97

Table A9. Sensitivity/specificity analysis of the relationship between food group diversity (FGI8) and Mean Micronutrient Density Adequacy (using MMDA-no iron ≥ 75% cutoff point), by FGI8 cutoff for non-breastfed infants 6-8 mo

Cutoffs	Sensitivity	Specificity	Positive predictive value	Proportion of false positives	Proportion of false negatives	Total proportion misclassified
Asia						
Philippines						
All child-days (w/ and w/o fortified products						
≥ 1	1.00	0.00	0.38	0.62	0.00	0.62
≥ 2	0.95	0.07	0.39	0.58	0.02	0.59
≥ 3	0.50	0.60	0.43	0.25	0.19	0.44
≥ 4	0.23	0.88	0.53	0.08	0.29	0.37
≥ 5	0.08	0.97	0.58	0.02	0.35	0.37
≥ 6	0.02	1.00	0.86	0.00	0.37	0.37
≥ 7	0.00	1.00	-	0.00	0.38	0.38
≥ 8	0.00	1.00	-	0.00	0.38	0.38
Non-fortified						
≥ 1	1.00	0.01	0.08	0.92	0.00	0.92
≥ 2	1.00	0.09	0.08	0.84	0.00	0.84
≥ 3	0.89	0.58	0.15	0.39	0.01	0.40
≥ 4	0.48	0.87	0.23	0.12	0.04	0.16
≥ 5	0.15	0.97	0.27	0.03	0.06	0.10
≥ 6	0.07	1.00	0.67	0.00	0.07	0.07
≥ 7	0.00	1.00	-	0.00	0.08	0.08
≥ 8	0.00	1.00	-	0.00	0.08	0.08
Fortified						
≥ 1	1.00	0.00	0.73	0.27	0.00	0.27
≥ 2	0.95	0.01	0.72	0.27	0.04	0.31
≥ 3	0.46	0.67	0.79	0.09	0.39	0.49
≥ 4	0.20	0.90	0.85	0.03	0.59	0.61
≥ 5	0.07	0.96	0.83	0.01	0.68	0.69
≥ 6	0.02	1.00	1.00	0.00	0.72	0.72
≥ 7	0.00	1.00	-	0.00	0.73	0.73
≥ 8	0.00	1.00	-	0.00	0.73	0.73
Latin America						
Peru (Trujillo)						
≥ 1	1.00	0.00	0.98	0.02	0.00	0.02
≥ 2	0.96	0.00	0.98	0.02	0.04	0.06
≥ 3	0.94	0.00	0.98	0.02	0.06	0.08
≥ 4	0.82	0.00	0.98	0.02	0.18	0.20
≥ 5	0.39	1.00	1.00	0.00	0.60	0.60
≥ 6	0.12	1.00	1.00	0.00	0.86	0.86
≥ 7	0.02	1.00	1.00	0.00	0.96	0.96
≥ 8	0.00	1.00	-	0.00	0.98	0.98

Table A10. Sensitivity/specificity analysis of the relationship between food group diversity (FGI8) and Mean Micronutrient Density Adequacy (using MMDA-no iron ≥ 75% cutoff point), by FGI8 cutoff for non-breastfed infants 9-11 mo

Cutoffs	Sensitivity	Specificity	Positive predictive value	Proportion of false positives	Proportion of false negatives	Total proportion misclassified
Asia						
Philippines						
All child-days (w/ and w/o fortified products						
≥ 1	1.00	0.00	0.30	0.69	0.00	0.69
≥ 2	1.00	0.03	0.31	0.68	0.00	0.68
≥ 3	0.67	0.54	0.39	0.32	0.10	0.42
≥ 4	0.31	0.84	0.46	0.11	0.21	0.32
≥ 5	0.10	0.96	0.54	0.03	0.27	0.30
≥ 6	0.03	0.99	0.58	0.01	0.29	0.30
≥ 7	0.00	1.00	0.50	0.00	0.30	0.30
≥ 8	0.00	1.00	-	0.00	0.30	0.30
Non-fortified						
≥ 1	1.00	0.00	0.14	0.86	0.00	0.86
≥ 2	1.00	0.03	0.14	0.84	0.00	0.84
≥ 3	0.86	0.54	0.23	0.39	0.02	0.41
≥ 4	0.48	0.84	0.32	0.14	0.07	0.21
≥ 5	0.18	0.96	0.42	0.03	0.11	0.15
≥ 6	0.04	0.99	0.38	0.01	0.13	0.14
≥ 7	0.01	1.00	0.50	0.00	0.14	0.14
≥ 8	0.00	1.00	-	0.00	0.14	0.14
Fortified						
≥ 1	1.00	0.00	0.77	0.23	0.00	0.23
≥ 2	0.99	0.00	0.77	0.23	0.01	0.24
≥ 3	0.57	0.56	0.81	0.10	0.33	0.43
≥ 4	0.22	0.93	0.91	0.02	0.60	0.61
≥ 5	0.06	0.98	0.90	0.01	0.72	0.73
≥ 6	0.03	1.00	1.00	0.00	0.75	0.75
≥ 7	0.00	1.00	-	0.00	0.77	0.77
≥ 8	0.00	1.00	-	0.00	0.77	0.77
Latin America						
Peru (Trujillo)						
≥ 1	1.00	0.00	0.98	0.02	0.00	0.02
≥ 2	1.00	0.00	0.98	0.02	0.00	0.02
≥ 3	0.93	1.00	1.00	0.00	0.07	0.07
≥ 4	0.86	1.00	1.00	0.00	0.13	0.13
≥ 5	0.56	1.00	1.00	0.00	0.43	0.43
≥ 6	0.25	1.00	1.00	0.00	0.73	0.73
≥ 7	0.12	1.00	1.00	0.00	0.87	0.87
≥ 8	0.02	1.00	1.00	0.00	0.97	0.97

Table A11. Sensitivity/specificity analysis of the relationship between food group diversity (FGI8) and Mean Micronutrient Density Adequacy (using MMDA-no iron ≥ 75% cutoff point), by FGI8 cutoff for non-breastfed children 12-23 mo

Cutoffs	Sensitivity	Specificity	Positive predictive value	Proportion of false positives	Proportion of false negatives	Total proportion misclassified
Africa						
Madagascar						
≥ 1	1.00	0.00	0.47	0.53	0.00	0.53
≥ 2	1.00	0.03	0.48	0.51	0.00	0.51
≥ 3	0.94	0.10	0.49	0.47	0.03	0.50
≥ 4	0.86	0.22	0.50	0.41	0.07	0.48
≥ 5	0.59	0.61	0.57	0.21	0.20	0.40
≥ 6	0.26	0.92	0.74	0.04	0.35	0.39
≥ 7	0.05	1.00	1.00	0.00	0.45	0.45
≥ 8	0.01	1.00	1.00	0.00	0.47	0.47
Asia						
India						
≥ 1	1.00	0.00	0.69	0.31	0.00	0.31
≥ 2	0.94	0.07	0.69	0.29	0.04	0.33
≥ 3	0.79	0.34	0.72	0.21	0.14	0.35
≥ 4	0.58	0.55	0.74	0.14	0.29	0.43
≥ 5	0.30	0.77	0.74	0.07	0.48	0.55
≥ 6	0.02	0.98	0.67	0.01	0.67	0.68
≥ 7	0.00	1.00	-	0.00	0.69	0.69
≥ 8	0.00	1.00	-	0.00	0.69	0.69
Latin America						
Brazil						
≥ 1	1.00	0.00	0.76	0.24	0.00	0.24
≥ 2	1.00	0.00	0.76	0.24	0.00	0.24
≥ 3	1.00	0.11	0.78	0.21	0.00	0.21
≥ 4	0.98	0.11	0.78	0.21	0.01	0.23
≥ 5	0.97	0.16	0.79	0.20	0.03	0.23
≥ 6	0.82	0.42	0.82	0.14	0.14	0.28
≥ 7	0.36	0.89	0.92	0.03	0.49	0.51
≥ 8	0.05	1.00	1.00	0.00	0.73	0.73
Peru (Trujillo)						
≥ 1	1.00	0.00	0.92	0.08	0.00	0.08
≥ 2	1.00	0.03	0.92	0.08	0.00	0.08
≥ 3	0.98	0.17	0.93	0.07	0.02	0.09
≥ 4	0.93	0.37	0.94	0.05	0.06	0.11
≥ 5	0.76	0.70	0.97	0.02	0.22	0.25
≥ 6	0.38	0.93	0.99	0.01	0.57	0.57
≥ 7	0.12	1.00	1.00	0.00	0.81	0.81
≥ 8	0.01	1.00	1.00	0.00	0.91	0.91

Table A12. Sensitivity/specificity analysis of the relationship between food group diversity (FGI7) and Mean Micronutrient Density Adequacy (using MMDA-no iron≥ 75% cutoff point), by FGI7 cutoff for breastfed infants 6-8 mo

Cutoffs	Sensitivity	Specificity	Positive predictive value	Proportion of false positives	Proportion of false negatives	Total proportion misclassified
Africa						
Ghana						
≥ 1	1.00	0.00	0.09	0.91	0.00	0.91
≥ 2	1.00	0.14	0.10	0.78	0.00	0.78
≥ 3	1.00	0.62	0.21	0.35	0.00	0.35
≥ 4	0.63	0.91	0.41	0.08	0.03	0.11
≥ 5	0.21	0.97	0.40	0.03	0.07	0.10
≥ 6	0.05	0.99	0.50	0.00	0.09	0.09
≥ 7						
Madagascar						
≥ 1	1.00	0.05	0.31	0.67	0.00	0.67
≥ 2	0.98	0.24	0.36	0.53	0.01	0.54
≥ 3	0.74	0.50	0.39	0.35	0.08	0.43
≥ 4	0.40	0.86	0.55	0.10	0.18	0.28
≥ 5	0.08	0.98	0.64	0.01	0.28	0.29
≥ 6	0.00	1.00	0.00	0.00	0.30	0.30
≥ 7	0.00	1.00	-	0.00	0.30	0.30
Malawi						
≥ 1	1.00	0.00	0.30	0.70	0.00	0.70
≥ 2	1.00	0.46	0.44	0.38	0.00	0.38
≥ 3	0.75	0.59	0.44	0.29	0.08	0.36
≥ 4	0.35	0.85	0.50	0.11	0.20	0.30
≥ 5	0.05	0.98	0.50	0.02	0.29	0.30
≥ 6	0.05	1.00	1.00	0.00	0.29	0.29
≥ 7	0.00	1.00	-	0.00	0.30	0.30
Asia						
Bangladesh						
≥ 1	1.00	0.00	0.06	0.94	0.00	0.94
≥ 2	1.00	0.61	0.14	0.37	0.00	0.37
≥ 3	1.00	0.89	0.38	0.10	0.00	0.10
≥ 4	0.00	0.98	0.00	0.02	0.06	0.08
≥ 5						
≥ 6						
≥ 7						
Philippines						
All child-days (w/ and w/o fortified products)						
≥ 1	1.00	0.00	0.14	0.86	0.00	0.86
≥ 2	0.96	0.43	0.21	0.49	0.01	0.50
≥ 3	0.61	0.79	0.32	0.18	0.05	0.24
≥ 4	0.20	0.95	0.42	0.04	0.11	0.15
≥ 5	0.02	0.99	0.33	0.01	0.14	0.14
≥ 6	0.01	1.00	1.00	0.00	0.14	0.14
≥ 7	0.00	1.00	-	0.00	0.14	0.14

(continued)

Cutoffs	Sensitivity	Specificity	Positive predictive value	Proportion of false positives	Proportion of false negatives	Total proportion misclassified
Non-fortified						
≥ 1	1.00	0.00	0.06	0.94	0.00	0.94
≥ 2	0.94	0.43	0.09	0.53	0.00	0.54
≥ 3	0.67	0.79	0.16	0.20	0.02	0.22
≥ 4	0.27	0.95	0.26	0.04	0.04	0.09
≥ 5	0.03	0.99	0.20	0.01	0.05	0.06
≥ 6	0.03	1.00	1.00	0.00	0.05	0.05
≥ 7	0.00	1.00	-	0.00	0.06	0.06
Fortified						
≥ 1	1.00	0.00	0.55	0.45	0.00	0.45
≥ 2	0.97	0.41	0.66	0.27	0.02	0.29
≥ 3	0.58	0.78	0.76	0.10	0.23	0.33
≥ 4	0.17	0.96	0.85	0.02	0.45	0.47
≥ 5	0.02	1.00	1.00	0.00	0.54	0.54
≥ 6	0.00	1.00	-	0.00	0.55	0.55
≥ 7	0.00	1.00	-	0.00	0.55	0.55
Latin America						
Honduras						
≥ 1	1.00	0.00	0.47	0.53	0.00	0.53
≥ 2	0.97	0.17	0.51	0.44	0.01	0.45
≥ 3	0.82	0.45	0.57	0.29	0.08	0.37
≥ 4	0.53	0.70	0.61	0.16	0.22	0.38
≥ 5	0.21	0.89	0.63	0.06	0.37	0.43
≥ 6	0.04	0.99	0.73	0.01	0.45	0.46
≥ 7	0.01	1.00	0.67	0.00	0.47	0.47
Peru (Huascar)						
≥ 1	1.00	0.00	0.31	0.69	0.00	0.69
≥ 2	0.98	0.26	0.38	0.51	0.01	0.52
≥ 3	0.80	0.46	0.40	0.37	0.06	0.43
≥ 4	0.58	0.77	0.54	0.16	0.13	0.29
≥ 5	0.14	0.97	0.70	0.02	0.27	0.29
≥ 6						
≥ 7						
Peru (Trujillo)						
≥ 1	1.00	0.02	0.72	0.28	0.00	0.28
≥ 2	1.00	0.17	0.75	0.23	0.00	0.23
≥ 3	0.92	0.46	0.81	0.15	0.05	0.21
≥ 4	0.71	0.79	0.89	0.06	0.21	0.27
≥ 5	0.35	0.94	0.94	0.02	0.47	0.49
≥ 6	0.08	1.00	0.98	0.00	0.66	0.67
≥ 7	0.00	1.00	1.00	0.00	0.72	0.72

Table A13. Sensitivity/specificity analysis of the relationship between food group diversity (FGI7) and Mean Micronutrient Density Adequacy (using MMDA-no iron ≥ 75% cutoff point), by FGI7 cutoff for breastfed infants 9-11 mo

Cutoffs	Sensitivity	Specificity	Positive predictive value	Proportion of false positives	Proportion of false negatives	Total proportion misclassified
Africa						
Ghana						
≥ 1	1.00	0.00	0.28	0.72	0.00	0.72
≥ 2	1.00	0.05	0.30	0.68	0.00	0.68
≥ 3	0.90	0.48	0.41	0.37	0.03	0.40
≥ 4	0.63	0.81	0.57	0.13	0.10	0.24
≥ 5	0.24	0.97	0.75	0.02	0.22	0.24
≥ 6	0.02	1.00	1.00	0.00	0.28	0.28
≥ 7						
Madagascar						
≥ 1	1.00	0.01	0.49	0.50	0.00	0.50
≥ 2	1.00	0.18	0.54	0.41	0.00	0.41
≥ 3	0.89	0.43	0.60	0.29	0.05	0.34
≥ 4	0.57	0.74	0.68	0.13	0.21	0.34
≥ 5	0.20	0.97	0.88	0.01	0.39	0.41
≥ 6	0.03	1.00	1.00	0.00	0.48	0.48
≥ 7	0.00	1.00	-	0.00	0.49	0.49
Malawi						
≥ 1	1.00	0.00	0.63	0.37	0.00	0.37
≥ 2	1.00	0.24	0.69	0.28	0.00	0.28
≥ 3	0.74	0.44	0.69	0.21	0.16	0.37
≥ 4	0.47	0.79	0.79	0.08	0.34	0.41
≥ 5	0.17	0.97	0.91	0.01	0.52	0.53
≥ 6	0.05	1.00	1.00	0.00	0.60	0.60
≥ 7	0.00	1.00	-	0.00	0.63	0.63
Asia						
Bangladesh						
≥ 1	1.00	0.00	0.13	0.87	0.00	0.87
≥ 2	1.00	0.36	0.20	0.55	0.00	0.55
≥ 3	0.89	0.83	0.44	0.15	0.01	0.16
≥ 4	0.33	0.97	0.60	0.03	0.09	0.12
≥ 5						
Philippines						
All child-days (w/ and w/o fortified products)						
≥ 1	1.00	0.00	0.12	0.88	0.00	0.88
≥ 2	0.96	0.35	0.17	0.57	0.01	0.58
≥ 3	0.69	0.71	0.25	0.26	0.04	0.30
≥ 4	0.33	0.94	0.45	0.05	0.08	0.13
≥ 5	0.06	0.99	0.44	0.01	0.12	0.13
≥ 6	0.00	1.00	-	0.00	0.12	0.12
≥ 7	0.00	1.00	-	0.00	0.12	0.12

(continued)

Cutoffs	Sensitivity	Specificity	Positive predictive value	Proportion of false positives	Proportion of false negatives	Total proportion misclassified
Non-fortified						
≥ 1	1.00	0.00	0.07	0.93	0.00	0.93
≥ 2	0.97	0.35	0.09	0.61	0.00	0.61
≥ 3	0.69	0.70	0.14	0.28	0.02	0.30
≥ 4	0.37	0.94	0.32	0.05	0.04	0.09
≥ 5	0.06	0.99	0.29	0.01	0.06	0.07
≥ 6	0.00	1.00	-	0.00	0.07	0.07
≥ 7	0.00	1.00	-	0.00	0.07	0.07
Fortified						
≥ 1	1.00	0.00	0.84	0.16	0.00	0.16
≥ 2	0.95	0.00	0.83	0.16	0.05	0.20
≥ 3	0.70	0.86	0.96	0.02	0.25	0.27
≥ 4	0.30	0.86	0.92	0.02	0.59	0.61
≥ 5	0.05	1.00	1.00	0.00	0.80	0.80
≥ 6	0.00	1.00	-	0.00	0.84	0.84
≥ 7	0.00	1.00	-	0.00	0.84	0.84
Latin America						
Peru (Huascar)						
≥ 1	1.00	0.00	0.43	0.57	0.00	0.57
≥ 2	1.00	0.10	0.45	0.52	0.00	0.52
≥ 3	0.94	0.32	0.51	0.39	0.02	0.41
≥ 4	0.66	0.67	0.60	0.19	0.15	0.33
≥ 5	0.28	0.91	0.70	0.05	0.31	0.36
≥ 6	0.07	0.99	0.80	0.01	0.40	0.40
≥ 7						
Peru (Trujillo)						
≥ 1	1.00	0.00	0.81	0.19	0.00	0.19
≥ 2	1.00	0.21	0.84	0.15	0.00	0.16
≥ 3	0.94	0.61	0.91	0.08	0.04	0.12
≥ 4	0.73	0.86	0.96	0.03	0.22	0.25
≥ 5	0.40	0.98	0.99	0.00	0.48	0.49
≥ 6	0.13	1.00	1.00	0.00	0.70	0.70
≥ 7	0.02	1.00	1.00	0.00	0.79	0.79

Table A14. Sensitivity/specificity analysis of the relationship between food group diversity (FGI7) and Mean Micronutrient Density Adequacy (using MMDA-no iron ≥ 75% cutoff point), by FGI7 cutoff for non-breastfed infants 6-8 mo

Cutoffs	Sensitivity	Specificity	Positive predictive value	Proportion of false positives	Proportion of false negatives	Total proportion misclassified
Asia						
Philippines						
All child-days (w/ and w/o fortified products)						
≥ 1	1.00	0.00	0.38	0.62	0.00	0.62
≥ 2	0.95	0.07	0.39	0.58	0.02	0.59
≥ 3	0.50	0.60	0.43	0.25	0.19	0.44
≥ 4	0.20	0.89	0.53	0.07	0.30	0.37
≥ 5	0.05	0.99	0.72	0.01	0.36	0.37
≥ 6	0.01	1.00	1.00	0.00	0.38	0.38
≥ 7	0.00	1.00	-	0.00	0.38	0.38
Non-fortified						
≥ 1	1.00	0.01	0.08	0.92	0.00	0.92
≥ 2	1.00	0.09	0.08	0.84	0.00	0.84
≥ 3	0.89	0.58	0.15	0.39	0.01	0.40
≥ 4	0.48	0.88	0.25	0.11	0.04	0.15
≥ 5	0.15	0.99	0.50	0.01	0.06	0.08
≥ 6	0.04	1.00	1.00	0.00	0.07	0.07
≥ 7	0.00	1.00	-	0.00	0.08	0.08
Fortified						
≥ 1	1.00	0.00	0.73	0.27	0.00	0.27
≥ 2	0.95	0.01	0.72	0.27	0.04	0.31
≥ 3	0.46	0.67	0.79	0.09	0.39	0.49
≥ 4	0.17	0.92	0.84	0.02	0.61	0.63
≥ 5	0.04	0.99	0.90	0.00	0.70	0.70
≥ 6	0.00	1.00	1.00	0.00	0.72	0.72
≥ 7	0.00	1.00	-	0.00	0.73	0.73
Latin America						
Peru (Trujillo)						
≥ 1	1.00	0.00	0.98	0.02	0.00	0.02
≥ 2	0.96	0.00	0.98	0.02	0.04	0.06
≥ 3	0.94	0.00	0.98	0.02	0.06	0.08
≥ 4	0.80	0.00	0.98	0.02	0.20	0.22
≥ 5	0.35	1.00	1.00	0.00	0.64	0.64
≥ 6	0.08	1.00	1.00	0.00	0.90	0.90
≥ 7	0.00	1.00	-	0.00	0.98	0.98

Table A15. Sensitivity/specificity analysis of the relationship between food group diversity (FGI7) and Mean Micronutrient Density Adequacy (using MMDA-no iron ≥ 75% cutoff point), by FGI7 cutoff for non-breastfed infants 9-11 mo

Cutoffs	Sensitivity	Specificity	Positive predictive value	Proportion of false positives	Proportion of false negatives	Total proportion misclassified
Asia						
Philippines						
All child-days (w/ and w/o fortified products)						
≥ 1	1.00	0.00	0.30	0.69	0.00	0.69
≥ 2	1.00	0.03	0.31	0.68	0.00	0.68
≥ 3	0.67	0.55	0.40	0.31	0.10	0.41
≥ 4	0.29	0.87	0.49	0.09	0.21	0.31
≥ 5	0.08	0.97	0.57	0.02	0.28	0.30
≥ 6	0.00	1.00	0.50	0.00	0.30	0.30
≥ 7	0.00	1.00	-	0.00	0.30	0.30
Non-fortified						
≥ 1	1.00	0.00	0.14	0.86	0.00	0.86
≥ 2	1.00	0.03	0.14	0.84	0.00	0.84
≥ 3	0.86	0.55	0.23	0.39	0.02	0.41
≥ 4	0.46	0.86	0.35	0.12	0.07	0.19
≥ 5	0.14	0.97	0.43	0.03	0.12	0.14
≥ 6	0.01	1.00	0.50	0.00	0.14	0.14
≥ 7	0.00	1.00	-	0.00	0.14	0.14
Fortified						
≥ 1	1.00	0.00	0.77	0.23	0.00	0.23
≥ 2	0.99	0.00	0.77	0.23	0.01	0.24
≥ 3	0.57	0.56	0.81	0.10	0.33	0.43
≥ 4	0.21	0.93	0.91	0.02	0.61	0.62
≥ 5	0.05	1.00	1.00	0.00	0.73	0.73
≥ 6	0.00	1.00	-	0.00	0.77	0.77
≥ 7	0.00	1.00	-	0.00	0.77	0.77
Latin America						
Peru (Trujillo)						
≥ 1	1.00	0.00	0.98	0.02	0.00	0.02
≥ 2	1.00	0.00	0.98	0.02	0.00	0.02
≥ 3	0.93	1.00	1.00	0.00	0.07	0.07
≥ 4	0.83	1.00	1.00	0.00	0.17	0.17
≥ 5	0.47	1.00	1.00	0.00	0.52	0.52
≥ 6	0.20	1.00	1.00	0.00	0.78	0.78
≥ 7	0.03	1.00	1.00	0.00	0.95	0.95

Figure A1. MMDA-no iron by FGI8: Breastfed infants 6-8 months

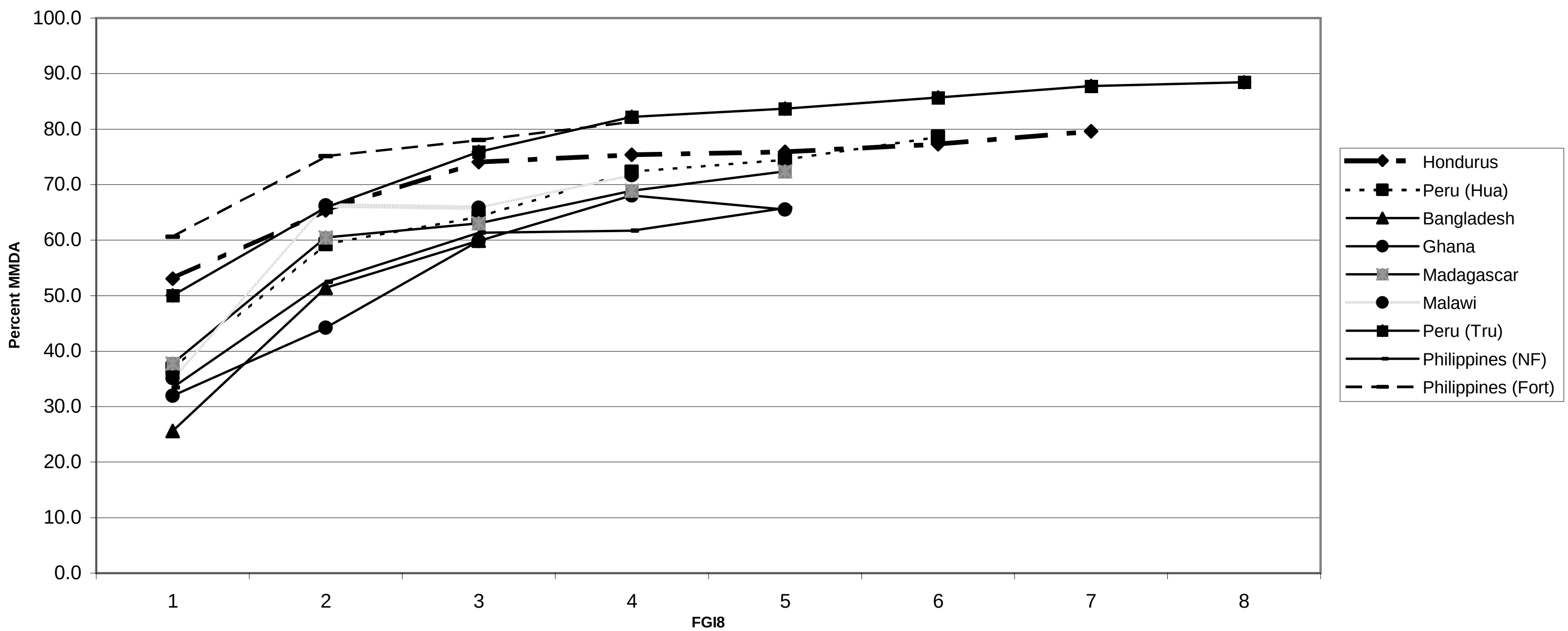


Figure A2. MMDA-no iron by FGI8: Breastfed infants 9-11 months

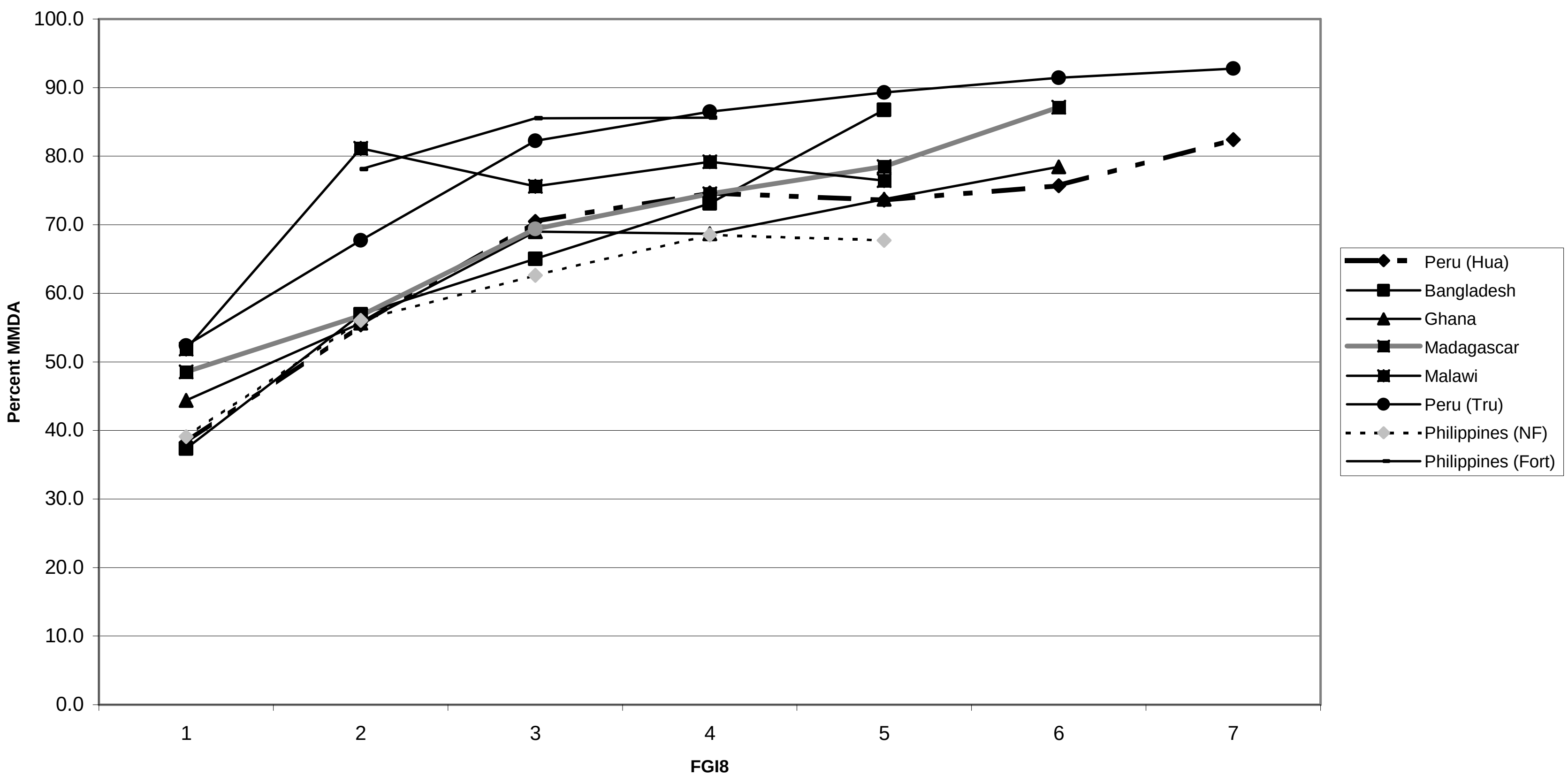


Figure A3. MMDA-no iron by FGI8: Breastfed children 12-23 months

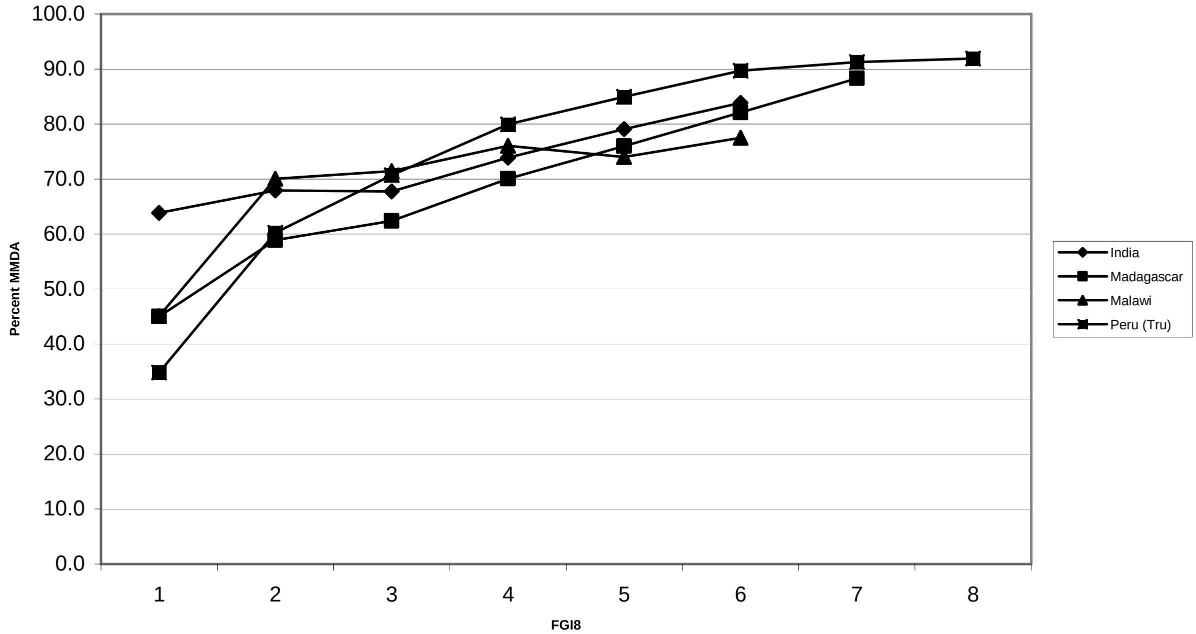


Figure A4. MMDA-no iron by FGI8: Non-breastfed infants 6-8 months

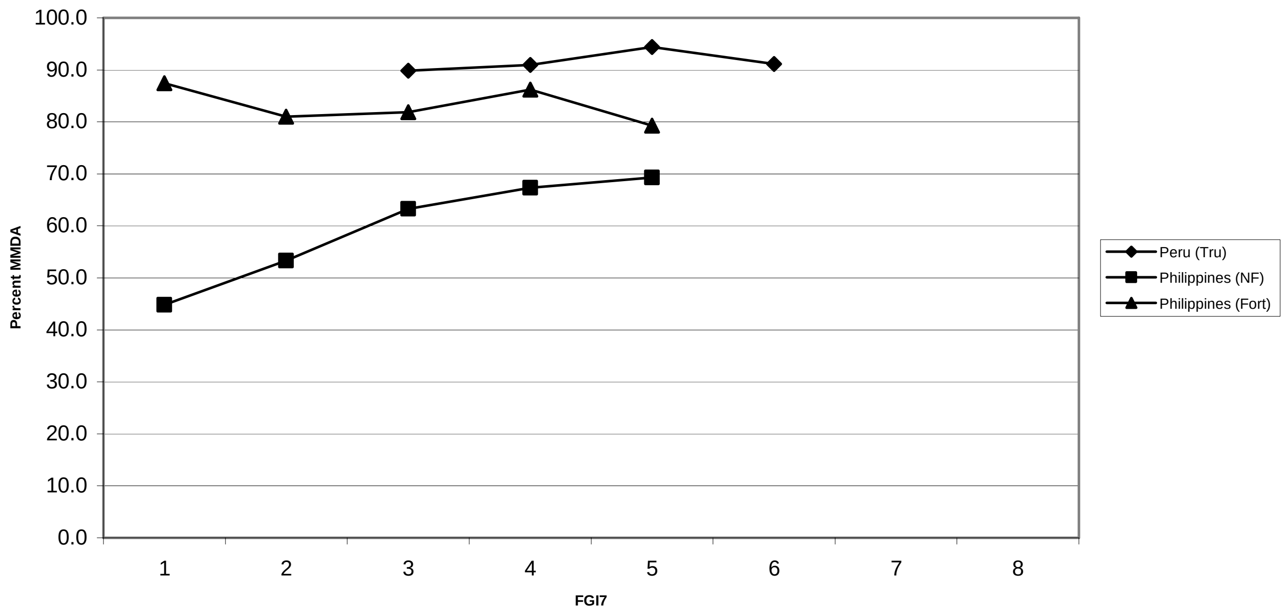


Figure A5. MMDA-no iron by FGI8: Non-breastfed infants 9-11 months

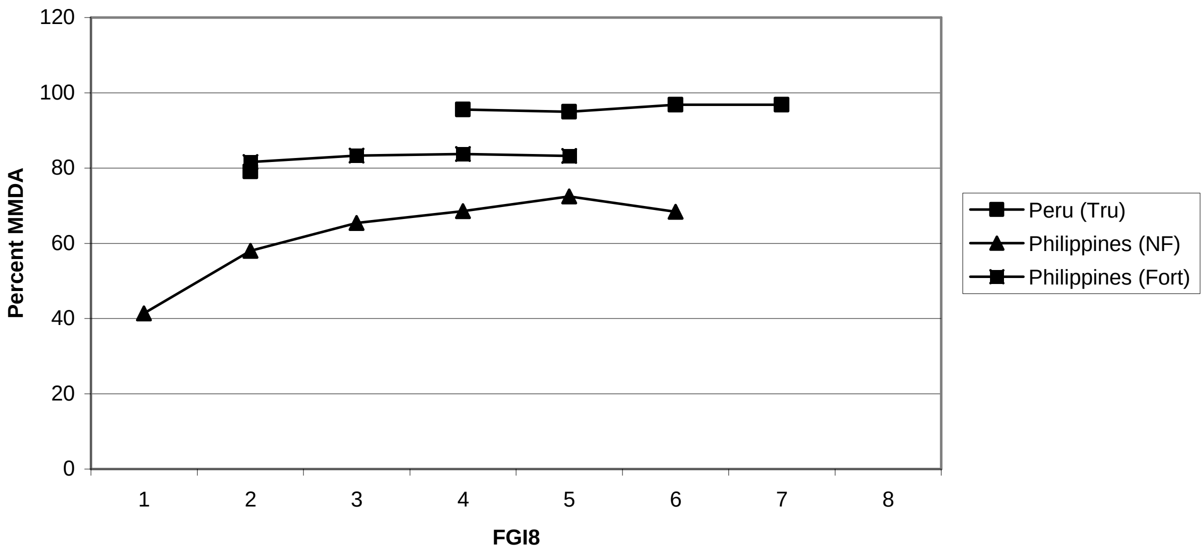


Figure A6. MMDA-no iron by FGI8: Non-breastfed children 12-23 months