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Supplement—Developing Simple Measures of Women's Diet Quality in Developing Countries: Methods and Findings

Developing Simple Measures of Women's Diet Quality in Developing Countries: Overview[1,2]

Marie T. Ruel,[3]* Megan Deitchler,[4] and Mary Arimond[5]

[3]Division of Poverty, Health and Nutrition, International Food Policy Research Institute, Washington, DC 20006; [4]FANTA-2, AED, Washington, DC 20009; and [5]Program in International and Community Nutrition, University of California

Micronutrient malnutrition is one of the most widespread yet largely neglected nutrition challenges faced by women living in the developing world today. An estimated 19 million pregnant women are vitamin A deficient due to poor diets (1), and 500 million women of childbearing age (~40%) are anemic (1, 2). The burden of these and other micronutrient deficiencies, such as zinc, iodine, and vitamin B-12, is particularly high in South Asia and sub-Saharan Africa (3). The consequences of micronutrient deficiencies among women are profound and far reaching; they affect not only the health and survival of women but also have long-term, irreversible effects on their offspring.

Poor maternal nutrition and health can also jeopardize the ability of women to care for their children, engage in income-generating activities, and protect household food security. One of the most important factors responsible for maternal micronutrient deficiency, along with disease burden, is poor diets lacking diversity. Diets of the poor are largely based on cereal or tuber staples and often lack vegetables, fruits, and animal source foods, which are rich in bioavailable micronutrients. Even in households where micronutrient-rich foods are available, inequities in intra-household distribution may prevent women from having access to a high-quality diet (4). Accurate information on women's diets and micronutrient intakes, however, is extremely scant due primarily to the challenge and cost of collecting and analyzing dietary data. Dietary intake data are time- and resource-intensive to collect and require careful processing and sophisticated analytic methods. The result is that most large data collection efforts, especially those carried out at the national level, have not included dietary intake data. Without data on women's dietary, and more specifically micronutrient, intake, however, progress in designing, targeting, and evaluating effective programs to improve women's micronutrient nutrition will continue to be hampered.

The Women's Dietary Diversity Project (WDDP)[6,7] was designed in 2005 specifically to respond to the need for generating simple yet valid indicators of women's dietary quality. This collaborative research initiative used existing dietary intake data from 5 resource-poor settings to document women's diet quality, defined as micronutrient adequacy, and to test whether food group diversity indicators (FGI) could be a useful tool in large-scale nationally representative surveys to predict women's dietary quality.

This journal supplement begins with a review of the literature on women's micronutrient intakes in Africa, Asia, and Latin America. This is followed by a presentation of empirical research findings from the WDDP initiative. These include results from analyses of 5 datasets on women's dietary patterns and nutrient intakes from vastly different settings, including both urban/peri-urban (Burkina Faso, Mali, Philippines) and rural (Bangladesh, Mozambique) areas. The analyses also document the relationship between simple indicators of dietary diversity and the micronutrient adequacy of women's diets in these settings. Collectively, the results highlight the nature and extent of the gap between women's micronutrient requirements and their dietary intakes in the 5 areas represented. They also confirm the potential usefulness of simple dietary diversity indicators as a proxy for women's poor diet quality in these environments. The results are particularly useful for helping focus attention on the critical problem of poor diet quality among women of reproductive age in resource-poor environments.

The systematic literature review by Torheim et al. (5) shows a consistent pattern of generally low micronutrient intakes among women in Africa, Asia, and Latin America, regardless of the

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* To whom correspondence should be addressed. E-mail: m.ruel@cgiar.org.

[6] Abbreviations used: FGI, food group diversity indicator; MPA, mean probability of adequacy; NPNL, nonpregnant, nonlactating; WDDP, Women's Dietary Diversity Project.

[7] The Women's Dietary Diversity Project (WDDP) is a collaboration among researchers from the International Food Policy Research Institute, AED, Fafo Institute for Applied International Studies, FAO, Institute of Research for Development, Iowa State University, London School of Hygiene and Tropical Medicine, University of North Carolina at Chapel Hill, and Wageningen University.

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methods used to assess dietary intake. The authors conclude that low dietary intakes of thiamin, riboflavin, vitamin B-6, folate, vitamin B-12, iron, and zinc are likely to be common among poor women in most developing regions of the world. Their findings also indicate that pregnant women and women in Asia and Africa may be at greater risk for inadequate intake than nonpregnant, nonlactating (NPNL) women and women in Latin America, respectively. This review also highlights the lack of representative data at the population level on women's dietary intakes. It further documents that very few studies have assessed micronutrient adequacy using currently recommended analytic methods such as the probability of nutrient adequacy. The authors stress the need for additional studies to characterize the extent of women's micronutrient inadequacy and to help identify appropriate interventions to improve the quality of women's diets.

Arimond et al. (6) provide some of the first documentation of micronutrient adequacy for women of reproductive age in resource-poor settings using the probability of adequacy method for 11 micronutrients (vitamin A, thiamin, riboflavin, niacin, vitamin B-6, folate, vitamin B-12, vitamin C, calcium, iron, and zinc). Analyses were done separately for NPNL women in all 5 sites and for lactating women in 3 sites (Bangladesh, Mozambique, and the Philippines). A summary measure, used to reflect the mean probability of adequate intake across the 11 micronutrients, is also reported for each site and physiologic group. The study shows that NPNL and lactating women have a low prevalence of adequacy for most of the micronutrients evaluated in both urban and rural areas. The mean probability of adequate intake is <0.55 for NPNL women in all 5 sites and <0.35 for lactating women in the 3 sites where data are available.

The study by Arimond et al. (6) is also the first, to our knowledge, to undertake a systematic assessment of different FGI as proxy measures of the micronutrient adequacy of women's diets using data from multiple sites and a standard protocol to guide the analysis. The study tested 8 FGI, where each FGI is comprised of 6, 9, 13, or 21 food groups and employs either a 1-g or 15-g minimum quantity of consumption for a food group to count in the FGI score. All 8 FGI were positively and significantly associated with the mean probability of adequate intake of 11 micronutrients in each of the 5 sites; the results highlight the value of excluding trivial amounts of food (<15 g in a group) from counting toward the FGI scores. The study demonstrates the potential of simple FGI to serve as a proxy measure of the micronutrient adequacy of women's diets. Although no single FGI performed best across all 5 sites, promising indicators could be identified in each site.

The study by Kennedy et al. (7) carried out site-specific research to explore which individual food groups predict greater mean probability of adequacy (MPA) of 11 micronutrients among NPNL women in Bamako, Mali. The study provides rich descriptive information about women's dietary patterns and micronutrient intakes and adequacy for 11 micronutrients. By exploring which food groups are associated with higher mean probability of adequate intake (>0.50), the authors highlight diet-based interventions that could help improve women's diet quality in this setting. In this study, the authors observed that intake of nuts and seeds, milk and yogurt, dark green leafy vegetables, and vitamin C-rich vegetables is positively and significantly associated with the estimated usual intake of 5 or more individual micronutrients and MPA of 11 micronutrients. Nuts and seeds and dark green leafy vegetables were also consumed by a large proportion of women in the sample, indicating that the foods were available and accessible in the study setting. The authors advocate for further research to assess whether increased consumption of foods within these food groups could indeed provide opportunities to improve women's diets in Bamako.

The study by Becquey and Martin-Prevel (8) also presents a site-specific analysis and explores opportunities to improve women's diet quality in Ouagadougou, Burkina Faso. The authors analyze the association between individual food groups and specific food consumption behaviors, and the MPA of 11 micronutrients. Analysis of these data reveals the importance of purchased ready-to-eat foods in the diets of urban women in Ouagadougou. The results show that nearly 50% of women's total energy intake is provided by foods bought outside the home and these ready-to-eat foods disproportionately contributed to women's sugar intake. The authors conclude that improving the quality of ready-to-eat foods may provide a valuable opportunity to increase the micronutrient adequacy of diets of women in urban Burkina Faso and recommend that studies be undertaken to assess the feasibility of increasing the nutrient density of these foods and the impact of such a strategy on women's diet quality.

The supplement concludes with a focus on operational and methodological issues related to data collection and analysis. The study by Martin-Prevel et al. (9) compares dietary diversity assessments using FGI derived from a list-based 24-h recall of food groups consumed (qualitative questionnaire) with those derived from a detailed quantitative 24-h recall. In one of the first studies to explore the issue, Martin-Prevel et al. identify substantive differences in the number of food groups reported as eaten when data were collected by qualitative as opposed to quantitative questionnaires. The study includes a rich set of analyses to test the relationship of FGI collected by qualitative and quantitative questionnaire to the MPA of micronutrients and to explore the determinants of differences in FGI reporting by the 2 methods. The results show that misreporting of nutrient-dense foods and foods eaten in small quantities is common. The authors discuss operational considerations for collecting data on women's diet quality in light of these findings, pointing out the trade-offs that must be considered when operationalizing simple FGI in large-scale surveys. The authors assert that FGI based on qualitative list-based questionnaires are promising tools for assessing diet quality at the population level but note that the approach needs to be adapted in each specific context to minimize FGI misreporting. They recommend that further research be carried out, both to characterize the type and extent of food group misreporting in various resource-poor contexts and to explore whether adapted methods can successfully minimize these errors.

Finally, the study by Joseph and Carriquiry (10) analyzes the statistical error inherent in various types of regression models that could be used to quantify the association between FGI and micronutrient adequacy. The authors discuss the correlation in error between usual FGI and usual MPA when derived from the same questionnaire and estimate the attenuation that may occur if 1 d FGI (single day of recall) is used to predict the usual MPA (multiple days of recall). The study reminds us to examine the assumptions and performance of the statistical models we use before drawing conclusions about the nature and strength of the relationship between variables.

The most consistent finding of the body of research presented in this journal supplement is that women's low micronutrient intake is a widespread (if not universal) problem across developing countries and in both urban and rural settings. The research also highlights the dearth of information on women's diet quality and micronutrient status and intake. Failure to

address this information gap in the future will continue to hamper action in tackling the neglected problem of maternal micronutrient malnutrition.

We draw the following main conclusions from the work of the WDDP. FGI were strongly associated with the micronutrient adequacy of women's diets in all sites included in the WDDP and can therefore be considered a meaningful proxy for this dimension of women's diet quality in most developing countries. The WDDP research did not identify a single indicator for global use, but strongly supports the development and use of site- or country-specific FGI. Food group misreporting (i.e. under- or overreporting when using a qualitative FGI derived from a list-based, 24-h recall of food groups consumed) is common; further research is needed to inform how best to address this data collection issue in different settings to minimize errors due to misreporting of food groups. And finally, we recommend the collection of nationally representative data on women's diet quality using FGI (if more resource-intensive methods are out of reach) to speed up efforts to help fill the information gap regarding the burden of women's micronutrient deficiency and poor nutrition.

Global, nationally representative data on women's dietary intakes and micronutrient adequacy are urgently needed to help characterize the magnitude and distribution of the problem, to mobilize resources to address it, and to effectively design, target, monitor, and evaluate actions aimed at reducing the burden of women's micronutrient malnutrition in the short and medium term. However, realistically, resource constraints are likely to continue to preclude collection of dietary data that provide precise and representative estimates of nutrient intakes in most developing countries. In the absence of this, FGI are useful measures that can help fill the information gap. These simple FGI indicators should continue to be tested in different contexts and for different purposes, including for screening and targeting interventions and for capturing change and response to interventions.

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Literature Cited

1. UNICEF. Tracking progress on child and maternal nutrition. A survival and development priority. New York: UNICEF; 2009.
2. UNICEF and Micronutrient Initiative. Vitamin and mineral deficiency. A global progress report. Ottawa (Canada): Micronutrient Initiative; 2009.
3. Black RE, Allen LH, Bhutta ZA, Caulfield LE, de Onis M, Ezatti M, Mathers C, Rivera J. Maternal and child undernutrition: global and regional exposures and health consequences. Lancet. 2008;371: 243–60.
4. Gittelsohn J, Vastine AE. Sociocultural and household factors impacting on the selection, allocation and consumption of animal source foods: current knowledge and application. J Nutr. 2003; 133(11 Suppl 2): S4036–41.
5. Torheim LE, Ferguson EL, Penrose K, Arimond M. Women in resource-poor settings are at risk of inadequate intakes of multiple micronutrients. J Nutr. 2010;140:2051–8.
6. Arimond M, Wiesmann D, Becquey E, Carriquiry A, Daniels MC, Deitchler M, Fanou-Fogny N, Joseph ML, Kennedy G, et al. Simple food group diversity indicators predict micronutrient adequacy of women's diets in 5 diverse, resource-poor settings. J Nutr. 2010; 140:2059–69.
7. Kennedy G, Fanou-Fogny N, Segheiri C, Arimond M, Koreissi Y, Dossa R, Kok FJ, Brouwer ID. Food groups associated with a composite measure of probability of adequate intake of 11 micronutrients in the diets of women in urban Mali. J Nutr. 2010;140:2070–8.
8. Becquey E, Martin-Prevel Y. Micronutrient adequacy of women's diet in Urban Burkina Faso is low. J Nutr. 2010;140:2079–85.
9. Martin-Prevel Y, Becquey E, Arimond M. Food group diversity indicators derived from qualitative list-based questionnaire misreported some foods compared to same indicators derived from quantitative 24-hour recall in Urban Burkina Faso. J Nutr. 2010;140:2086–93.
10. Joseph ML, Carriquiry A. A measurement error approach to assess the association between dietary diversity, nutrient intake, and mean probability of adequacy. J Nutr. 2010;140:2094–2101.