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Mainstreaming nutrition metrics in household surveys—toward a multidisciplinary convergence of data systems

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Since the 2008 food price crisis, food and nutrition security are back on the global development agenda, with particular emphasis on agricultural pathways toward improved nutrition. Parallel efforts are being promoted to improve the data and metrics for monitoring progress toward positive nutritional outcomes, especially for women and children. Despite the increased investment in tracking nutritional outcomes, these efforts are often made in silos, which create challenges for integrating nutritional data with other sectoral data, such as those related to agriculture. This paper proposes a minimum set of nutrition indicators to be included in nationally representative agricultural (and multitopic) household surveys. Building multisectoral convergence across existing surveys will allow us to better identify priority interventions and to monitor progress toward improved nutrition targets.

Keywords: agriculture; household surveys; nutrition metrics; diet diversity scores

Introduction

The 2008 food price crisis has brought food and nutrition security to the forefront of the development agenda after a two-decade hiatus.[1–3] Specific attention is being paid to the role of agricultural development in rural poverty reduction and individual nutrition enhancement.[4,5] Improving the nutritional status of women of reproductive age and children, especially those under 2 years of age, is at the center of attention of the nutrition and broader development community.[6,7] Numerous global and national efforts aimed at improving maternal and child health and nutrition are underway (e.g., the Scaling Up Nutrition (SUN) initiative). In India, the Integrated Child Development Services program has implemented breastfeeding and complementary feeding programs, which have been shown to improve child dietary intake, hemoglobin levels, and morbidity.[8] Similar programs are underway in Bangladesh, Pakistan, and other parts of South Asia. Parallel efforts are underway for improving the metrics for assessing the current state of, and future changes in, individual nutritional status. Donor emphasis on quantitative target setting and impact assessment has been driving the current renewed and widespread interest in metrics.

While investments in improved household data and metrics have increased significantly over the past 5 years, they continue to operate in sectoral silos, which create challenges for integrating nutritional data with other data, such as those related to agriculture. In any given country, one can observe family health and nutrition surveys that run parallel to other agricultural, nutrition, income, labor, or consumption surveys. These surveys are facilitated by national entities, (e.g., ministries of agriculture, health, or environment) in addition to intergovernmental organizations or multinational institutions. Given the lack of communication and convergence across disciplines, sectors, and organization types, opportunities for converging and learning have remained limited.

For example, in countries such as Benin, Bangladesh, Côte d'Ivoire, Mali, and Gambia, the Multi Indicator Cluster Surveys undertaken by the United Nations Children's Fund (UNICEF) collects and evaluates data around similar topics as

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the U.S. Agency for International Development–funded Demographic and Health Survey (DHS). Meanwhile, similar and relevant information on agriculture, income, and health are collected in some of the above countries by the latest generation of the World Bank's Living Standards Measurement Study–Integrated Surveys on Agriculture (LSMS–ISA) data collection effort in conjunction with respective ministries of agriculture, health, and labor. Standardization and comparison across time and countries—especially for critical nutrition outcomes such as child stunting and wasting, or women's body mass index (BMI)—remain challenging when one goes beyond health surveys, such as the DHS. Empirically relating nutrition outcomes to key impact pathways is generally not possible with data investments that are currently underway.

Recent discussion around the possible agricultural pathways that influence nutrition have been undercut by the fact that little or no nutrition information has been collected in existing agriculture surveys. That is also the case for relating nutrition outcomes to other pathways, such as water and sanitation, and education or childcare practices. This paper calls for a minimum set of nutrition metrics—that is, a one- to two-page nutrition module that can be easily inserted into existing surveys—so that essential nutrition information can be collected alongside other data collection efforts. This minimum set of nutrition metrics is not meant to replace the need for more detailed nutrition or health surveys, such as the DHS, but rather to popularize a short nutrition module that can be incorporated into other sectoral surveys. Throughout the remainder of this paper we discuss how an essential set of nutrition metrics could specifically strengthen the linkages between, and understanding of, the agriculture and nutrition nexus by inserting this short nutrition module into the many agriculture surveys that are already underway. More broadly, however, we promote this minimum set of nutrition metrics for use in surveys that span other sectors in order to build convergences and understand the multidimensional factors that contribute to improved nutrition outcomes.

Multisectoral convergence for improved nutrition

Much thinking has revolved around conceptualizing the causal pathways for improving nutrition.[9] Agricultural pathways, in particular, have been credited with the potential to improve the food system and create new opportunities for households to afford and access foods through, for example, improved productivity, access to diverse diets, and fortification efforts. Other frameworks, such as that created by UNICEF, have pointed out that simply focusing on food is not enough. One must also consider how inadequate dietary intake, along with asymmetrical intrahousehold distribution, early childhood care practices, disease, and poor health environments, contribute equally to household and individual nutrition.[7,9]

The ability to improve maternal and child nutrition is influenced by four interlocking pathways to improved nutrition (Fig. 1), including (1) the income pathway, where gains in household income can translate to better food affordability (among other impacts); (2) the food supply pathway, including the availability of food (with respect to the diversity, quality, and quantity of food) year round and for vulnerable subpopulations; (3) the intrahousehold access pathway, where behavior-change interventions and improved care practices lead to equitable food allocation among individuals within a common household; and finally (4) the environmental health pathway, which links access to clean water and improved sanitation/hygiene practices to better nutritional health. Women's empowerment and status in the household plays an important role across all four quadrants. Empowered women are better able to ensure intrahousehold equity in food distribution and improved child care practices. Women's empowerment also influences women's labor productivity and income earning potential and hence improved access to food and diet quality.

As shown on the left side of Figure 1, food access is premised on the ability to afford and access an array of nutrient-dense foods. Food affordability requires the expansion of household budgets to allow rural households to purchase the quantity, quality, and diversity of food needed. Household incomes are determined by the productivity of smallholder farmer operations and the opportunities available for increased income opportunities (i.e., linking farmers to domestic and global food value chains) and nonfarm income opportunities. The seasonality and volatility of these market opportunities are of special consideration and importance.

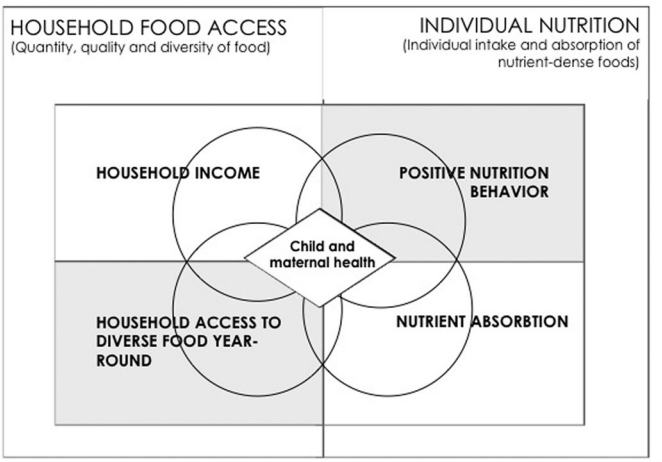

Figure 1. Multisectoral pathways toward improved maternal and child nutrition.

However, increased income and expansion of food budgets must be matched by actual food availability and improved dietary quality. Dietary quality is determined by a number of factors, including the spatial location of the household, their proximity to a variety of food retailers year round, and on-farm diversification and home cultivation (e.g., kitchen gardens and backyard livestock). Diet quality may also be influenced by policy efforts to increase rural access to food diversity through food and cash transfer programs and safety net programs for vulnerable populations.

On the right side of Figure 1, barriers to individual nutrition access and absorption, including intrahousehold food allocation and nutrient absorption, are identified. A household is made up of individuals who may differ in individual food intake and individual food needs; which is to say, that even if a household can access and afford adequate quantities of food with sufficient diversity, individual nutrition outcomes within a household may not always be achieved owing to intrahousehold inequities in food allocation. In some cultures, food distribution within a household may favor men and older boys, allowing them to eat first and select the amount and quality they desire. Women and young children are often left with the food that remains. Women's empowerment can shift these dynamics and encourage more positive nutrition behavior that ensures intrahousehold equity in food access.

Yet even if an individual comes from a household that is able to afford and access a variety of nutritious food and enough is distributed to meet her needs, the environment she lives in can determine her biological ability to absorb energy and nutrients. Drinking water supply and sanitation around the world continues to be inadequate, and intestinal inflammation and infection due to drinking water that is contaminated with worms, parasites, viruses, and bacteria leads to partial or complete malabsorption of essential nutrients to calories, in addition to life-threatening dehydration.

A number of mediating factors influence household income, access to nutritious foods, nutrient absorption and utilization, and household food allocation. The income (pathway 1) and the food supply (pathway 2) have the most obvious connection to agriculture, given the dependency of the rural poor on these activities for income as well as the ability to influence the quality, quantity, and diversity of the overall food supply. However, improvements along some pathways can create ripple effects for others. For example, improvements in women's

income earning opportunities (e.g., through investment in agricultural technologies for women) can promote women as decision makers within the household and promote more equal access to household resources—including better quality or quantities of food. Similarly, public investments in clean water access can support rural communities to comply with the food quality and safety regulations that are otherwise a barrier to entering higher value agricultural markets.

Multisectoral indicators for nutrition improvement

The four pathways described above are all individually important for improving nutrition; however, their collective impact can be significantly greater with respect to the speed and magnitude of change. An individual's ability to access, afford, accept, or absorb sufficient nutrients depends on a variety of integrated economic, social, and environmental factors, some of which may need to be met simultaneously if health and nutrition outcomes are to be achieved. For example, an individual suffering from anemia may not have year-round access to iron-rich food owing to any number of policy, income, or infrastructure shortcomings. She may also suffer from parasites or water-borne diseases that complicate nutrient uptake, and she may live in a household that deprioritizes equal access to food for women. Policies for enhancing maternal and child nutrition ought to necessarily take into account the convergence across the multisectoral pathways.

Designing an integrated set of interventions that can have significant impact on nutritional status will require a set of multisectoral indicators and metrics that help assess the current state and track changes over time. Much of the required data exist today but are often buried in sector-specific surveys with limited ability to combine data across sectors. Even established multipurpose surveys, such as the World Bank's LSMS, do not have adequate metrics for tracking individual nutritional status. In this section, we propose a minimum set of multisectoral indicators for tracking nutrition improvement that can provide some generalizable proxies for assessing basic nutrition status. The indicators proposed in Figure 2 are closely associated with the multisectoral nutritional pathways described earlier.

Maternal and child nutrition indicators

Stunting, wasting, and intrauterine growth restriction is a cause of 3.1 million child deaths annually or 45% of all child deaths in 2011.[10] The prevalence of stunting in children younger than 5 years—though decreasing during the past two decades—affects 200 million children in Sub-Saharan Africa and South Asia.[10] These maternal and child risk factors are collectively termed *undernutrition*. Concentrated efforts to reduce undernutrition in children and safeguarding of long-term child cognitive development and growth requires a sharp focus on the health and well-being of current and future mothers, especially those currently of reproductive age (15–45 years old).[11,12]

Among other factors, low maternal BMI is associated with intrauterine growth restriction (constrained fetal nutrition during a crucial period for brain development), and the concentration of micronutrients in breast milk is dependent on maternal status and intake, which means that the risk of infant depletion and long- and short-term growth and cognitive development is closely linked to maternal deficiency.[7,12,13]

Links between child and maternal nutrition continue far beyond the pregnancy and breastfeeding period. For women, iron deficiency—either because of diet, pregnancy, parasites, or disease—has been found to affect work capacity and immune function as well as changes in cognition and behavior.[7,13,14] Globally, the World Health Organization estimates that anemia, the most severe form of iron deficiency, affects up to 30% of nonpregnant women of reproductive age and 42% of pregnant women, and 47% of schoolchildren worldwide.[7] Iron-deficiency anemia (low iron intake from poor diets) is thought to be responsible for the majority (60%) of anemia cases globally.[7]

In addition to iron-deficiency anemia, vitamin A deficiency (VAD) greatly contributes to the overall disease burden of malnutrition. VAD, along with zinc, represents one of the largest disease burdens in newborn babies, infants, and children, and is responsible for 6% of deaths for children under 5 years old.[7] Aside from disease and death, VAD is responsible for impairing long-term cognitive and physical development. In the following section, we present a minimum set of anthropometric and biochemical markers for assessing the nutritional status of women and children.

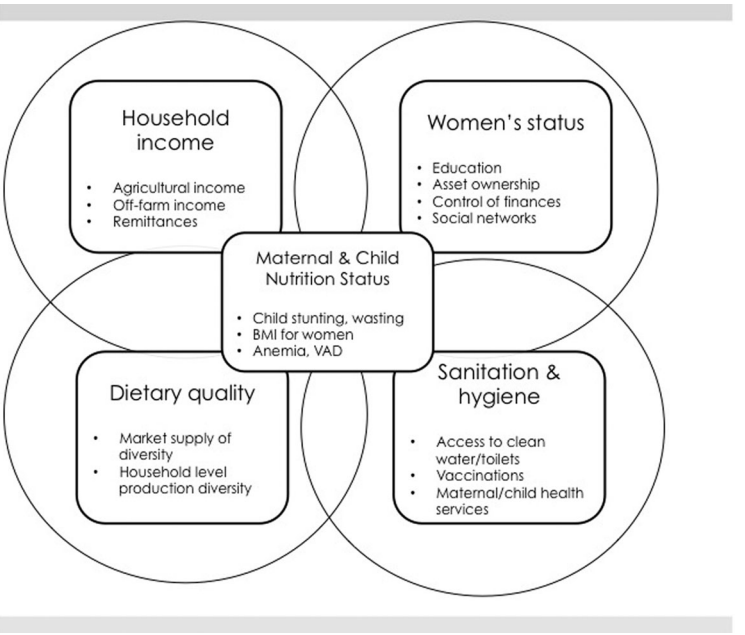

Figure 2. Multisectoral indicators for nutrition improvement (MINI).

Household income

Increasing total household income and expanding food budgets is central to a household's ability to afford the quantity, quality, and diversity of food needed for human nutrition. In rural areas, household incomes are determined by the productivity of smallholder farmer operations and market linkages (i.e., linking farmers to domestic and global food value chains) in addition to nonfarm income opportunities. Despite their dependency on agriculture, most rural households are net-food buyers, relying on proceeds from cash crops and off-farm employment to generate the earnings needed to supplement their own food crop production with market purchases.[15]

Opportunities and policies favoring agricultural commercialization can enable linkages between farmers, traders, and food retailers (beyond household income, indicators include, e.g., access to inputs, technology, and extension). Overall, improvements in income through farm productivity can be essential to improving relative food affordability. A core component of most agriculture surveys are metrics evaluating on-farm productivity and rural household income. Increasingly, agriculture surveys are also looking to better understand the contribution of nonfarm income and remittances to rural household income.

Dietary quality

Strong evidence exists for linking low dietary diversity to a number of micronutrient inadequacies. As mentioned, VAD and anemia are two of the biggest burdens for global undernutrition and evidence suggests that the majority of anemia and VAD is diet related.[7] Lack of dietary diversity is a particularly severe problem among poor populations in the developing world because diets are dominated by starchy staples and grains, with little or no animal products and few fresh fruits and vegetables.[5,16–18] Accurately assessing a household's and individual's access to a diverse diet is a key measurement area, useful for identifying how food insecurity can contribute to malnutrition[16,19,20] and childhood stunting.[21]

Access to dietary quality can be improved by enhancing market supply of micronutrient- and protein-rich foods through traditional and modern retailers. Additionally, access to quality diets can be improved by promoting on-farm diversification and the implementation of kitchen gardens and backyard livestock production. In the following section,

we discuss the most essential metrics for evaluating market supply of food diversity as well as household and individual diet quality.

Women's status in the household

In addition to the food supply factors described earlier, asymmetries in intrahousehold food access can play a major role in determining the nutritional status of women and children. A number of cultural and socioeconomic behaviors, norms, and beliefs—including those that affect women's empowerment—can have a profound influence on an individual's ability to make decisions and consume and control resources.[7,8,22,23] Understanding the relationship between intrahousehold behavior and nutrition outcomes is complex and not easy to generalize across geographies and cultures. However, there are some common markers that can be effective as proxies for the status of women in the household (Fig. 2). Education, women's ownership of assets, control of household finances, and participation in social networks could be effective proxies. While the first two are relatively easily captured in standard household surveys, the latter two require further work for determining the specific metrics that can be tracked.

Sanitation and health

It is well established that access to clean drinking water, and sanitation and hygiene, are essential for positive nutrition outcomes.[24,25] These factors related to a healthy environment determine the ability of the body to absorb nutrients from the food consumed. Despite their importance, the above factors are generally not considered in most agricultural and rural household surveys. Significant work needs to be done to determine the minimum set of environmental health indicators that contribute to improved maternal and child nutrition outcomes. However, obtaining information on household access to clean drinking water and toilets could be a great start, of relevance to multisectoral surveys for tracking multidimensional nutrition pathways.

Metrics and measurement considerations in assessing nutritional status

The ability to address nutrition in a multisectoral manner is restricted by the availability of a set of nutrition metrics that are commonly collected as part of existing agricultural and other sector-specific surveys. This section presents a minimum set of anthropometric, biochemical, and dietary diversity indicators that can be used to assess individual nutrition status (Table 1). These metrics are designed for use in association with other sector-specific indicators, such as income, water and sanitation, and women's empowerment, in order to identify gaps in specific pathways toward improved nutrition.

Anthropometry indicators

Anthropometric measures are widely used to assess and predict performance, health, and survival of individuals and to reflect the economic and social well-being of populations.[26] Age, sex, length/height, and weight are the four building blocks (measures) used to undertake anthropometric assessment. Combined, these variables represent an index that can provide essential information that can identify instances of stunting, wasting, and undernutrition (acute or chronic) as well as obesity in children. In adult populations, the conventional standard for anthropometric measures is to use BMI, which is a function of mass (weight) and height, relative to population standards.

Biochemical markers for anemia and VAD

While fairly straightforward anthropometric measurements of height, weight, age, or sex can be helpful in classifying chronic malnutrition (by identifying incidences of stunting, wasting, and high or low BMI), identifying micronutrient malnutrition or acute malnutrition requires the collection of different information. Biochemical testing can be extremely helpful in identifying the levels and functioning of various proteins, lipids, vitamins, and minerals that can illuminate a variety of current health conditions and deficiencies. In particular, anemia and VAD contribute significantly to the overall disease burden of malnutrition and are essential metrics to be tracked for assessing nutritional status. The biochemical markers for identifying anemia and VAD are hemoglobin and retinol, respectively.

Increasingly, new methods for collecting, transporting, and processing human samples—particularly blood—have reduced transaction costs and simplified the use and collection of biochemical information. Dried bloodspots (DBS) is a particularly useful and effective way for measuring iron and vitamin A deficiencies. A DBS sample collection requires only a few drops of blood from a

Table 1. Minimum set of nutrition metrics for assessing nutrition status

Nutrition pathway	Indicator category	Indicator(s)	Metric(s)
Maternal and child nutrition status			
	Anthropometric	• Stunting	• Height (recumbent length, if less than 2 years old)
		• Wasting	• Weight
		• BMI for women	• Age
	Biochemical	• Anemia	• Gender
		• Vitamin A deficiency (VAD)	• Hemoglobin levels
			• Retinol levels
Dietary quality and food access			
	Dietary diversity	• Household-level food access	• Household-level dietary diversity score (HDDS)[a]
		• Individual dietary intake	• Women's dietary diversity score (WDDS)[a]
	Market-level food supply	• Market supply of diverse food	• Rapid market food supply analysis

[a]See the Food and Agriculture Organization (FAO) Guidelines for Measuring Household and Individual Dietary Diversity.[31]

finger or a heel-prick. The blood collection cards are easily labeled, transported, and stored. Transportation to an analysis center or laboratory may not require subzero temperatures and reduces costs and inconvenience.[27] Beyond easier collection, transport, and storage, additional advantages of using DBS include access to younger and more remote populations and decreased risk of disease transmission.[27–29]

Dietary diversity scores

Dietary diversity is defined as the number of different foods or food groups that are consumed by a household or individual over a reference period.[30] Most dietary diversity indicators use simple counting of foods or food groups and derive a food group or dietary diversity score for an individual or a household. Scoring is done by using the food groups outlined in the Food and Agriculture Organization (FAO) Guidelines for Dietary Diversity Scoring, which suggest between 9 and 16 core food groups.[31] The FAO Guidelines allow for information collection at either the household level (giving the household-level dietary diversity score or HDDS), which identifies household economic access to food, or measures individual food access. The latter scoring system has been designed specifically for assessing the nutrition status of women (known as the Women's Dietary Diversity Score or WDDS) for individuals of reproductive age (15–49 years old). The WDDS identifies the probability of micronutrient adequacy—in particular, access to vitamin A and iron-rich foods—by including specific food categories for vitamin A–rich fruits and vegetables as well as dark leafy greens (generally with higher levels of iron and/or additional micronutrients). Combined, these two dietary diversity indicators allow for insights into household economic access to dietary diversity (HDDS) as well as an individual's micronutrient-adequate diet (WDDS).[a]

Beyond assigning appropriate food groups, divergent methodological approaches and analysis have developed. This includes differences in allowable quantities (i.e., what and how much "counts"), cutoffs (relative differences that reflect seasonality, location, and context), recall periods, and quantifying or qualifying the difference between capturing dietary diversity and dietary quantity, which is to say, the relationship between nutrients to energy rather than on absolute levels of intake.[16] Differences in nutrient composition and bioavailability and differences among individual groups (e.g., pregnant women, infants, or the elderly) are additional

[a]A recent consensus reached by an international group of nutritionists has renamed WDDS as MDD-W.[34]

considerations. Further methodological issues around the use and operationalization of diet diversity scores have been well documented.[16,32,33]

Market-level dietary diversity scoring

While the HDDS can identify a particular household's economic access to dietary diversity, it does little to capture the quality and diversity available in the local food supply. Especially for micronutrient- and protein-dense foods (specifically vegetables, fruit, dairy, and meat products), a market-level dietary diversity score (MLDD) can illuminate why households may be deficient in dietary quality and suggest where interventions need to be made. Put another way, if a poor MLDD is found, it suggests that household access to dietary diversity might be prohibited by something more than just the relative cost of micronutrient- or protein-dense foods to staples. Households simply do not have the option to purchase a diverse diet because of poor rural market development. Investments in agricultural production and market-level mechanisms (e.g., credit, storage, transportation) might need to be undertaken in order to ensure the presence of these micronutrient- and protein-dense foods for purchase by individual households. In short, the MLDD contributes to an accurate understanding of local market supply and offers the ability to better target interventions for improving the supply of dietary diversity.

The way forward

The United Nations is expected to embark on a new set of globally accepted goals and targets for sustainable development for the post-2015 development agenda (Sustainable Development Goals (SDGs)). While continued emphasis on significant reductions in poverty and hunger is expected, adoption of explicit targets for reducing child stunting and for addressing the nutritional needs of pregnant and lactating mothers are being promoted by the nutrition community. Explicit targets on women's empowerment and universal access to clean water and sanitation are also being promoted. While agreeing on a common set of global goals and targets is important, the challenge is in the implementation of the post-2015 agenda at the country level.

Tracking progress on the SDGs requires a common set of metrics that are comparable across countries and over time. Tracking progress using national statistics is generally not adequate, especially since data on many of the SDG goals and targets are generally not collected. Internationally comparable data on maternal health, nutrition, and child stunting are particularly weak, as are the data on gender empowerment, water, and environmental health. Investing in internationally comparable metrics for tracking progress toward the SDG goals is as important as agreeing on the goals and targets. As discussed earlier, there are numerous sector-specific household surveys that can be used for tracking progress toward the SDGs.

In the case of nutrition targets, a minimum set of metrics for tracking progress in maternal and child nutrition and women's status ought to be identified and incorporated into existing nationally representative agricultural and multitopic surveys. At the very least, the common set of indicators ought to include anthropometric and dietary diversity variables as discussed earlier. Further work needs to be done to identify a common set of metrics for food access, water, sanitation, and other environmental health variables.

Obtaining data on a set of biochemical markers, such as iron and vitamin A deficiency, is becoming easier with the use of DBS and potentially easier with technologies that do not need blood extraction. Incorporating biochemical markers into existing household surveys can transform our ability to quantitatively understand the multidimensional pathways toward nutrition improvement.

Conflicts of interest

The authors declare no conflicts of interest.

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