Access to adequate nutritious food: New indicators to track progress and inform action

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Abstract

New indicators are needed to provide information on access to and consumption of adequate nutritious food. These indicators would fill a basic information gap necessary to understand the causes of malnutrition, and to inform policy options to support food security and nutrition. Globally-used indicators for the causal factors of malnutrition expanded with the publication of the UNICEF Framework on the Causes of Malnutrition in 1990, with the addition of a number of indicators to measure the constructs of "health" and "care" in national datasets. Indicators of the "food" domain, however, have remained virtually unchanged since the 1960s, largely derived from the single indicator of national-level dietary energy supply. This simple and uni-dimensional characterization of "food" was a guidepost toward real and pressing needs 50 years ago, but it is no longer adequate or fitting to the nutritional realities of today's food systems, or the distribution of nutritional problems throughout the world.

Currently, against the backdrop of a push to improve nutrition through agriculture that is stronger now than at any time since the 1970s, there is a need to update the measurement of food security at global scale. The 2013 State of Food Insecurity in the World (FAO, IFAD, WFP), the primary source of global and country-level food security information, for the first time lists a suite of 30 indicators meant to capture different dimensions of food security: a change from the

traditionally-reported indicators of dietary energy supply and prevalence of calorie inadequacy. Indicators on access to adequate nutritious food, and dietary quality, are still missing. Suggestions are made for how new food indicators can be mainstreamed in the nutrition and agriculture datasets and parlance, to shift the generalized construction of "food" from one of caloric adequacy, to one of complete food security: safe, sufficient, and nutritious food for a healthy and active life. This is particularly relevant in the conversations leading up to the monitoring framework for the post-2015 development agenda.

Introduction

Access to adequate food for all is a globally held vision. It is a goal of the United Nations Zero Hunger Challenge, endorsed last year by the UN Secretary General, which includes as one of five goals: "100% access to adequate food all year round". In some form, a food security goal will certainly be part of the post-2015 Sustainable Development Goals as well. These sets of goals succeed the Millennium Development Goals (MDGs), which spanned the period from 1990-2015. In defining top priorities and targets, the MDGs have shaped the direction of development efforts among governments, donors, and non-profit organizations, and created accountability toward the goals.

"Access to adequate food" seems like an obvious, desirable, and foundationally important goal to equity, well-being, and human development. But what, exactly, *is* access to adequate food? And what is the agriculture and food sector – which is by far the largest contributing sector to food – supposed to do about it? How is "access to adequate food" defined and measured, so as to enable accountability toward that goal? A precedent was set in the MDGs, in which the only food target

is *halving the proportion of people unable to access adequate calories*. The precedent for that particular target and indicator goes back at least 50 years. As the post-2015 development agenda is being debated, it is timely to revisit whether that target guides development efforts in a direction appropriate for addressing food problems in the world today.

The origins of current indicators: half a century ago

In the 1960s-70s, it was clear what was meant by "adequate food," and it was equally clear what agriculture was supposed to do about it. There were famines and fears of mass food shortages, amidst alarm about population growth. The Green Revolution raised yields of major cereals dramatically; the CGIAR system formed in 1971, first with the International Rice Research Institute (IRRI) and the International Center for Improvement of Maize and Wheat (CIMMYT), with the aim to improve productivity of the major staple grains. The concept of "food security" first arose in 1974, defined as "availability at all times of adequate world food supplies." (UN 1975)

At the same time, nutritional concerns were being recognized to contribute to poor national development in addition to human development (Berg 1967, Berg 1973). These concerns led to growing global interest in nutrition.[1] The main nutrition problems were considered to be deficiencies of calories and proteins; and with this focus, agriculture's key role was thus to provide adequate and equitable access to calories among the poor.[2] Interestingly, part of the

[1] For example, the World Bank created a nutrition unit for the first time in 1973, based on the rationale that malnutrition contributes to poverty.

[2]According to a World Bank policy document, "The major nutrition problem in the world today, according to most nutritionists, is insufficient intake of calories, or food energy." (World Bank 1980) Another report stated, "Although

reason for this focus may have been linked to the data that were available to understand the malnutrition problem. Data on actual malnutrition prevalence were remarkably scarce. Estimates were made based on national per capita food supplies, in the absence of virtually any nationally representative surveys of child anthropometry or micronutrient status.[3] Therefore, increasing food supply would necessarily bring down estimated rates of malnutrition.

Data on prevalence and causes of malnutrition have evolved

In the 1980s-90s, malnutrition rates started to be measured directly at national scale. Data on child and adult anthropometry are collected regularly in nearly all countries since the mid-1990s (UNICEF 2006), primarily through the Demographic and Health Surveys (DHS, which started in 1984), UNICEF's Multiple Indicator Cluster Surveys (MICS, started in the mid-1990s), and other nationally representative surveys (such as India's National Family Health Survey which started in 1992, for example). Biochemical or clinical indicators of micronutrient deficiencies are collected in some of these surveys.

National survey data are compiled in annual United Nations agency reports, which are important sources of information on the prevalence and causes of malnutrition globally and by country.

deficiency of vitamins and minerals may cause serious health problems, especially among children, the therapy is now well known and relatively easy to apply so that the magnitude of this problem is almost negligible in relation to the one created by lack of calories and proteins." (Chafkin et al. 1972)

[3] FAO SOFA 1975, p75: "Most of the present knowledge of nutritional problems has had to be derived from national average figures of per caput food supplies, because of the inadequate number of reliable household consumption, budgetary and clinical surveys. While still far from adequate, the limited available information is, however, sufficient to demonstrate some of the broad features of the nutritional situation, the awesome magnitude of the problem, and the urgent need for action."
SCN 1987 First Report on the World Nutrition Situation: "These analyses must be regarded as of a tentative nature because of the scarcity of data on child anthropometry which would provide the basis for a robust assessment of trends."

National and global reports provide the basis for surveillance, for tracking progress toward goals, for cross-country comparisons and analyses, and for informing policy to support public wellbeing. They also provide the basis for advocacy and problem-framing: "In addition to identifying the problems and measuring the number of people affected, information from [food security and nutrition monitoring] is also used for sensitizing the public and the decision makers in the government and donor community." (Babu and Pinstrup-Andersen 1994). The indicators collected and reported globally started (and in many ways continue) by emphasizing nutrition as a problem of hunger, and then shifted toward nutrition as a problem of inadequate infant and child care practices, sanitation, and health services. (See Table 1.)

In the 1970s, the main data available for causal analysis of nutrition problems were only related to food: Dietary Energy Supply (DES) and protein supply.[4] As data improved on malnutrition prevalence in the late 1980s-mid-1990s, understanding of the causes of malnutrition sharpened as well. The main underlying causes of malnutrition are now understood to be inadequate food, health, and care; and the immediate causes are inadequate dietary intake and disease (UNICEF 1990). In 1980, UNICEF published the first of what would become its annual flagship publication: State of the World's Children (SOWC). Although the initial report contained no data tables, in years that followed, the UNICEF SOWC statistical annexes became a standard reference compiling the available data on indicators related to child survival and development, and child nutrition. Countries' most recent anthropometric data are published annually in

[4] These were published in the State of Food and Agriculture (SOFA) reports, the flagship publication of the UN Food and Agriculture Organization (FAO).

UNICEF's State of the World's Children report, and periodically in the UN SCN Reports on the World Nutrition Situation.

Consistent with the theory about causes of malnutrition, the UNICEF SOWC data tables in the 1980s-mid-1990s included several indicators of the *health* situation and indicators of *care practices* (focused on breastfeeding). As for *food* causes of malnutrition, UNICEF and SCN initially published dietary energy supply and undernourishment statistics.[5] In 1998, all food indicators disappeared from the UNICEF SOWC report. Incidentally, that was the first year that the report's theme was "nutrition," seeming to suggest that food – or, at least the indicators available to represent food – was not relevant to a causal analysis of malnutrition.

The *health* and *care* indicators have evolved over time with advances in knowledge, data and research.[6] Even anthropometric indicators have evolved: in 2013, UNICEF SOWC began reporting prevalence of child obesity, as data become available in more countries. In contrast, the *food* indicators have not fundamentally changed since the 1970s; they still reflect availability and access to calories. Dietary intake data are not available either. While many country surveys collect dietary intake information using diverse methods and indicators, the DHS and MICS surveys do not, and there are no globally-comparable indicators of diet quality compiled or published.

[5] These continue to be published yearly in FAO's State of Food Insecurity in the World reports. According to the FAO, "Undernourishment refers to the condition of people whose dietary energy consumption is continuously below a minimum dietary energy requirement for maintaining a healthy life and carrying out a light physical activity" (FAOSTAT). By using data on income inequality, the undernourishment indicator added an element of "access" to the construct which had previously only been about national-level supply.

[6] For example, indictors on infant feeding shifted to *exclusive* breastfeeding, and timely introduction of complementary foods; the exact indicators have sharpened over time.

Table 1: Indicators on the causes of malnutrition published in UN agency flagship reports[7]

	Food	Health	Care
1970s	Dietary Energy Supply Protein supply		
1980s- mid-90s	Dietary Energy Supply Undernourishment Supply of iron and vitamin A*	Access to safe water Access to health services Immunization	Breastfeeding to 3 mos Breastfeeding to 6 mos Breastfeeding to 12 mos
1998	Dietary Energy Supply Undernourishment	Access to safe water Access to adequate sanitation Immunization ORT use	Exclusive breastfeeding at 0-3 mos Breastfeeding & complementary food at 6-12mos Breastfeeding at 20-23mos
2013	Dietary Energy Supply Undernourishment Protein supply % calories from starches	Access to safe water Access to adequate sanitation Immunization ORS use Vitamin A supplementation	Early initiation of breastfeeding Exclusive breastfeeding to 6 mos Introduction of solid/semi-solid/soft foods 6-8mos Breastfeeding at age 2yrs

Sources: UNICEF SOWC, SCN Reports on the World Nutrition Situation, FAO SOFA and SOFI reports

* The supply of iron and vitamin A in food was published in the first SCN Reports on the World Nutrition Situation (1987, 1992) only for the purpose of estimating the prevalence of iron and vitamin A deficiencies, since no biochemical data were available.

The concept of food security has evolved

The concept of food security was new in 1974, where at the World Food Summit it was defined as "availability at all times of adequate world food supplies." (UN 1975) In the twenty years that followed, the concept of food security evolved and, in reality, diversified (Pinstrup-Andersen and Herforth 2008), as some stakeholders continued to place primary importance on world food supplies even as new theory and analyses showed that world or even national supplies were not sufficient for the poor to obtain adequate food (Sen 1982, Pinstrup-Andersen 1984). The current agreed definition of food security emerged from the 1996 World Food Summit, as "physical and

[7] Notes:
UNICEF SOWC in the 1980s also had indicators of "Index of food production per capita"
UNICEF SOWC 1998, % consuming iodized salt appeared
FAO SOFI 2013 also includes in the suite of indicators: "% protein from animal origin" and "average value of food production" but what these are supposed to indicate regarding food security is not explained in the report.

economic access to sufficient, safe, nutritious food to meet dietary needs and food preferences for a healthy and active life." (FAO 1996) While in the 70s, the major concern was world food supplies, the concern now is *access* to food – and not just sufficient calories, but *safe and nutritious* food for a healthy and active life. The definition also clarifies that income is not enough to guarantee access to adequate food year round; inadequate availability and physical access (such as proximity or ease of obtaining food) can be barriers as well.

Why haven't food indicators evolved?

When world leaders agreed to a new food security definition nearly 20 years ago, no clear indicators or targets accompanied it. Ensuring commitment to "nutritious food to meet dietary needs" would seem to be a major nutrition issue, but advocacy around it was limited. The attention of nutrition community was away from food at the time, strongly focused on other causes of malnutrition that were seen as more limiting, and interventions that were seen as more cost-effective.[8]

The first UNICEF SOWC report, 1980, emphasized: "The major lesson of the last 20 years is that reductions in malnutrition cannot be achieved only by increases in food production." (Grant 1981).[9] In the 1970s, a lot of effort had been put into multisectoral nutrition planning, including a focus on agriculture to increase food access among the poor and nutritionally vulnerable, with the main focus on calories and protein. Political commitment to nutrition beyond basic food

[8] For a comprehensive review of nutrition priorities over time, see World Bank 2014.
[9] This echoed advocates for improving the contribution of agriculture, who had said that aggregate food production was not sufficient – that nutritional objectives needed to be explicit, and that agriculture investments needed to target the poor and nutritionally vulnerable (Pinstrup-Andersen 1981, World Bank 1980).

increases did not materialize, however. The field of nutrition moved away from multisectoral planning, and attention went elsewhere during a period sometimes referred to as "nutrition isolationism" (Levinson and McLachlan 1999), during which time the field of nutrition incubated its story, data, and priorities. Research focused on micronutrients, breastfeeding, community-based interventions to treat malnutrition, and on exposing the consequences of malnutrition. The capstone of this coalescing evidence base for nutrition resulted in the 2008 *Lancet series on maternal and child undernutrition*, which prioritized direct nutrition interventions that had been studied and honed over the previous 20-30 years, strongly supported by a clear storyline on the costly consequences of undernutrition. The prevalence, causes and consequences of poor diets were not part of the evidence base.

The nutrition community's distant relationship with food issues since the 1970s, though, is perhaps consistent with its earliest roots. Since vitamin deficiencies were discovered around the turn of the century, the main responses were nutrient and food supplementation, food fortification, and nutrition education.[10] Poor *diet quality* has been traditionally primarily treated as a personal affair: either medical (solved by supplementation – or now, bariatric surgery), or behavioral (solved by nutrition education), but rarely systemic (solved by food and economic policy). A case could be made that this tradition is rooted in gendered fields of study and influence: women studied nutrition within home economics, and could address dietary intakes via nutrition education; agricultural economics, which dealt with agricultural research and

[10] The first USDA dietary guidelines, "How to Select Foods" by Caroline Hunt and Helen Atwater, was published in 1917.

policy, was primarily the realm of men and did not often deal with nutrition directly.[11] If nutrition education efforts were the primary tool to improve dietary intake (i.e. attempts to change *care practices*), in conjunction with micronutrient supplements for missing nutrients, then these would be the main relevant factor to track. Indeed, the only dietary quality indicator currently available is for young children, and was created to reflect care practices (WHO 2008).[12]

Urban Jonsson has observed that paradigm shifts occur when "the old paradigm increasingly fails to explain phenomena or causes of a problem…Paradigm shifts are most often the result of either new scientific discovery and/or a changing 'ethical climate', influenced by changing political and ideological positions. Sometimes both take place." (Jonsson 2009) The field of nutrition may now be at the cusp of a new paradigm that emphasizes food systems. There is renewed emphasis on agriculture as part of the twin-track agenda of nutrition-specific and nutrition-sensitive development introduced with the Scaling Up Nutrition (SUN) movement. And increasingly, the evidence shows that the range of nutrition problems today has a great deal to do with food.

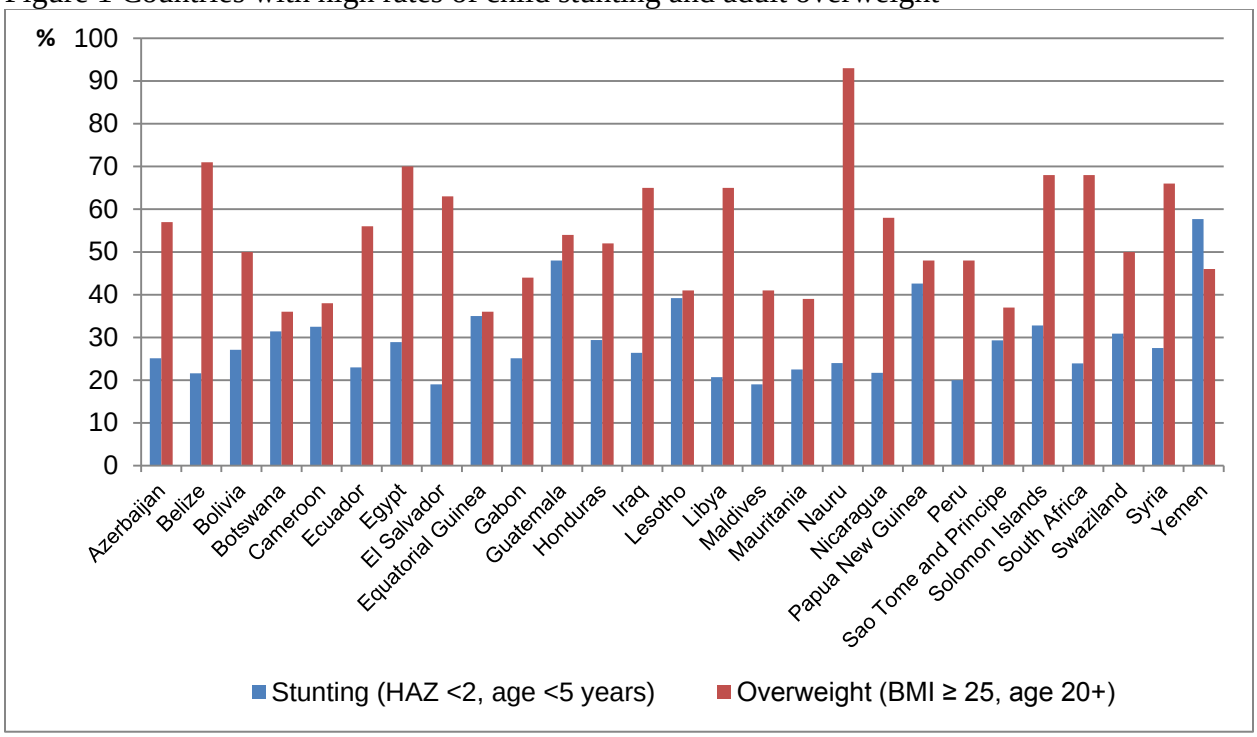
The nature of nutrition problems has changed

The prevalence of nutritional problems has shifted over time. The range of nutritional problems today is sometimes referred to as the "triple burden" of malnutrition (Gómez et al. 2013): undernutrition (stunting affects 165 million children), micronutrient deficiencies (estimated to

[11] It was in the 1970's when agricultural economists became involved (e.g. Pinstrup-Andersen 1977), as systemic issues became a focus in nutrition within multisectoral nutrition planning (Berg 1987).
[12] Minimum acceptable diet indicator (WHO 2008), which is collected in DHS and MICS surveys.

affect 2 billion people), and overweight/obesity (affecting 1.5 billion people) and related non-communicable disease. These coexist in the same countries, and even the same households and individuals. Among 80 countries identified as "high stunting-burden" (child stunting rates of 20% or higher), one-third have adult overweight/obesity rates of over 35%, and 15 high stunting-burden countries have overweight/obesity rates of 50% or greater (Figure 1). Sub-Saharan Africa and South Asia – the regions with the highest burden of child undernutrition – are also projected to have the highest increases in diabetes by 2030 (International Diabetes Federation 2011). These statistics show that obesity and related chronic disease is not only a problem for wealthy nations or people. In fact, they are more problematic for the poor, since the poor are more likely to develop and die from untreated diet-related chronic disease (such as diabetes) than the wealthy (WHO 2010).

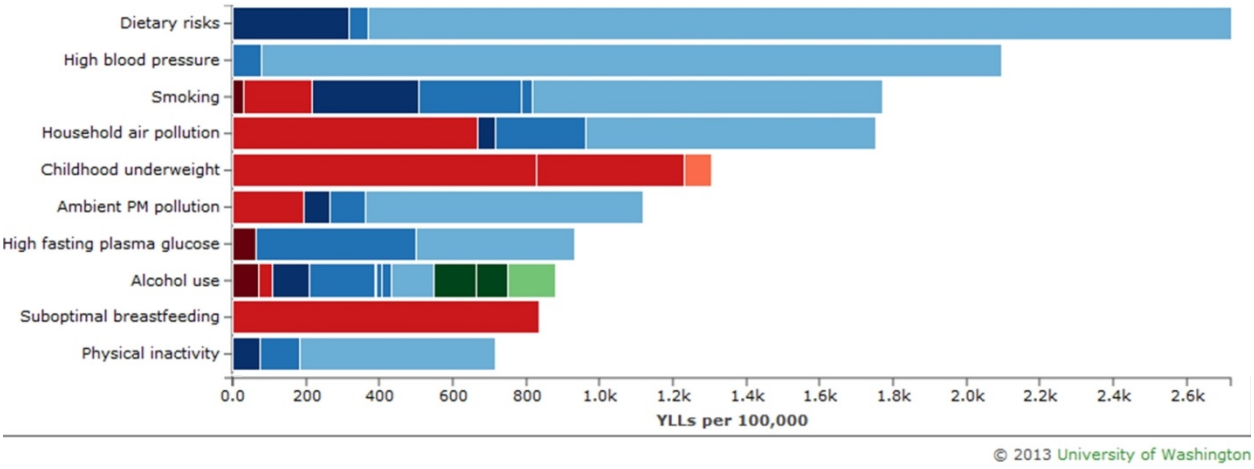
Figure 1 Countries with high rates of child stunting and adult overweight



Data source: WHO Global Health Observatory Data Repository, UNICEF Statistics by Area

The coexistence of these nutrition problems is unquestionably related to poor diets and the types of food people can access. The main non-communicable diseases are attributable mainly to diet. The Institute for Health Metrics and Evaluation reports that dietary risks are by far that top cause of disability-adjusted life years (DALYs) and years of life lost for all developing countries combined (IHME 2013) (Figure 2).[13] Among the top contributors to dietary risks are low fruit and vegetables, high sodium, low nuts and seeds, low whole grains, low omega-3 fatty acids, low fiber, and high processed meat (IHME 2013).

Figure 2 Top 10 causes of years of life lost; all developing countries, 2010



Data source: Institute for Health Metrics and Evaluation, "GBD Compare" data visualization tool

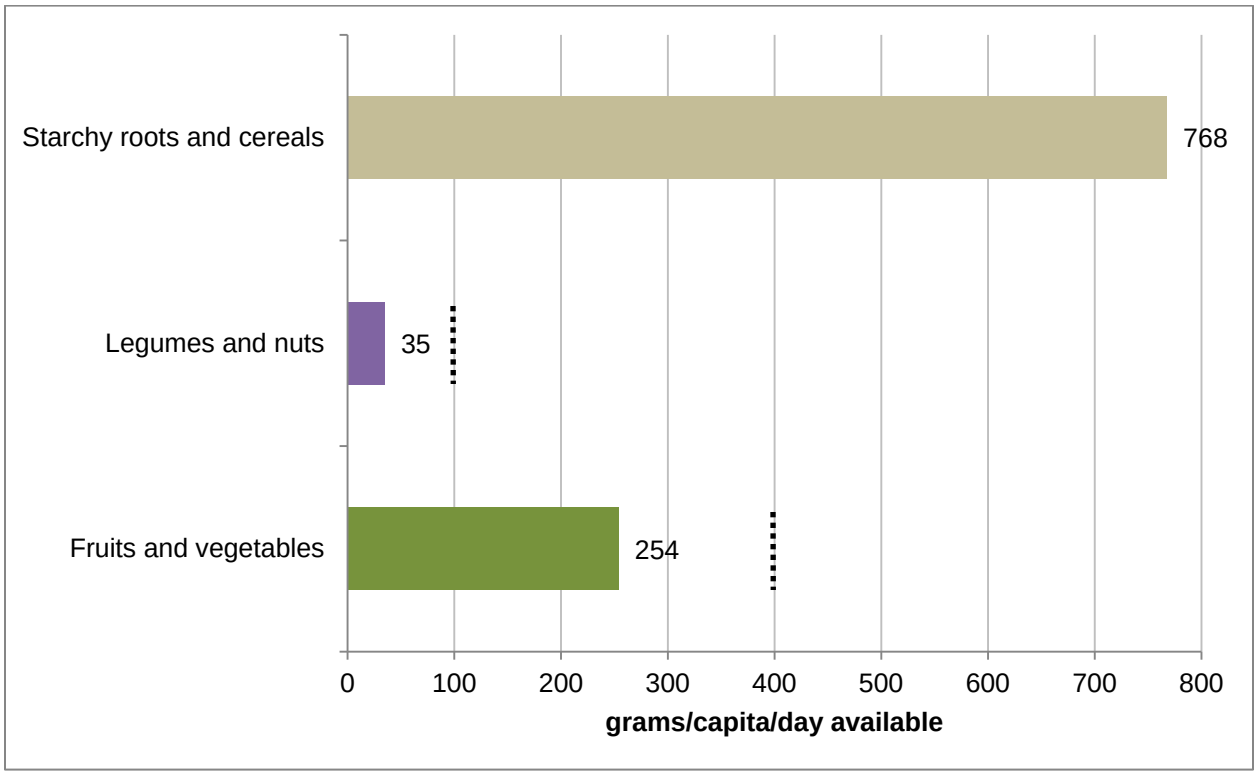
[13] The calculation of dietary risks to years of life lost only deals with those related to non-communicable disease, and not undernutrition, so it is likely an underestimate of the overall impact of poor diets.

Inadequate access to nutritious food

The available data suggest that it in many countries is not possible for most of the population to access adequate nutritious food to meet dietary needs even if they could afford it. Figure 3 shows that based on food availability data from sub-Saharan Africa, starchy roots and cereals would be expected to dominate diets, as they do. Fruits, vegetables, and pulses are not available enough, let alone affordable enough, for all people to have nutritious diets. There are just 254g of fruits and vegetables available/capita/day – compared to 400g/day recommended by WHO and FAO (2003). Only 35g of pulses are available/capita/day in sub-Saharan Africa, which is well below the amount that would be needed to meet protein needs in combination with starches.[14] These are precisely the food groups lacking in diets associated with greater years of life lost (IHME 2013). Low availability of non-staples is reflected in high prices. In Bangladesh, consumption and expenditure surveys showed that staple foods made up over 80% of energy, with non-staple plants about 15% and animal-source foods <4%, but each of three food groups required approximately one-third of the household food budget (Bouis et al. 2011). If dietary guidelines are believable as evidence-based standards of nutritious diets, and if food availability and price data are believable, then there is clear evidence of inadequate access to food.

[14] In the absence of an amount specified by dietary guidelines, this is one way to estimate need, which may be appropriate since legumes are the primary protein source for the poorest. (Methodology found in Herforth 2010.) Their contribution to dietary quality goes beyond protein, however, due to their fiber and phytonutrient content. Several studies in high-income countries have shown greater consumption of legumes and nuts to be associated with a variety of improved health outcomes, including reduced all-cause mortality (Bao et al. 2013).

Figure 3 Food Availability in Sub-Saharan Africa



Data source: FAOSTAT, 2009 data. Bars represent amounts available for consumption; dotted lines represent estimated nutritional needs.

Increasing access to unhealthy food

Markets respond to demand signals, and the conventional wisdom says that if incomes are sufficient, the food environment should be a good reflection of the kinds of foods people want to consume. For example, a key message of the FAO SOFA 2013 report, stated in the report's executive summary and on its landing webpage: "Consumers ultimately determine what they eat and therefore what the food system produces."[15] While demand undoubtedly influences production, there are other influences too: for example policies that provide incentives or

[15] The same FAO report also states: "…governments, international organizations, the private sector and civil society can all help consumers make healthier decisions…by providing information and ensuring access to diverse and nutritious foods."

disincentives for certain kinds of production, production constraints or risk associated with producing certain crops or livestock, and barriers to entry from one kind of crop/livestock production to another.

It is also worth considering where the demand is coming from. Pinstrup-Andersen has observed that "In high-income and rapidly growing low-income countries, the agricultural sector has become or is rapidly becoming a supplier of raw materials for the food processing industry, rather than a provider of food for direct consumption." (Pinstrup-Andersen 2013). The food processing industry is both script-writer and translator between individual consumers and agricultural producers, and can shape what the food system produces through direct contracts with farmers, their own research and development, and political influence of agri-food policy. Ultra-processed foods are increasingly available and marketed in low and middle-income countries (Monteiro et al. 2010), demanding increased production of ingredients for these foods (primarily refined starches, oils, and sugars) at the same time as supply of nutritious minimally-processed foods is constrained.

Eating norms and habits can change over time, and are influenced by the kinds of food available, affordable, convenient and marketed. Much of the research documenting what is known as "the nutrition transition" documents a convergence of patterns in disparate places, consistent with availability, convenience, and marketing of less-healthy foods (Popkin 2004, Popkin et al. 2005, Sobal 1999). Research on dietary patterns of immigrants shows a robust trend of acculturation to the norms and types of food available in the new country (Satia-Abouta et al. 2002). These

studies of the nutrition transition and dietary acculturation of immigrants offer strong evidence that food environments shape personal choice.

If healthy diets are more expensive and less convenient than unhealthy diets, then diet quality is unlikely to be optimized through the traditional tools of the nutrition community (nutrition education) and agricultural economics (income generation) alone. It is improbable that nutrition education will cause people to spend their income counter to market signals. It is even more improbable if eating habits and food preferences have shifted toward unhealthy ultra-processed foods, and away from healthy food preferences present in many traditional diets.

Why is it important to monitor access to adequate nutritious food and dietary quality?

Because the food environment is created not only by consumer preferences, but by multiple supply-side and demand-side factors, there is a role for policy to influence those factors. Current food data are insufficient for informing actions to improve access to nutritious food, and to create incentives (and remove disincentives) for better nutrition. Three main reasons food data need to be expanded include:

1. Consistency with ideals

Simply put, the food indicators collected and reported today do not match the vision for food security of *access to sufficient, safe, nutritious food to meet dietary needs…*, set forth by the global community almost 20 years ago (FAO 1996). Using food-based dietary guidelines as a basis, access to "nutritious food to meet dietary needs" should be tracked.

2. Ability to identify major causes of malnutrition

Indicators of access to and consumption of adequate nutritious food are basic data that are, to date, missing in the world's ability to identify causes of malnutrition. Great strides have been made in the monitoring of nutritional status, infant and young child care practices, and health risk factors; infectious disease prevalence is also well-monitored. These data enable analysis of the important causes of malnutrition in a given country or region, and appropriate policy options to address them. Current indicators of food, however, do not allow for understanding food causes of malnutrition beyond lack of calories. Access to calories is not closely correlated with undernutrition,[16] suggesting that either food access is irrelevant to nutrition (improbable), or the way it is measured needs improvement. In addition, dietary quality is the factor probably most synonymous with a layperson's or policy maker's concept of nutrition, but data to describe it are missing. At a time when the triple burden of malnutrition exists in all regions and income levels, and diet quality is a key factor underlying all of these forms of malnutrition, it is an almost unbelievable data gap that no globally-comparable indicators of dietary quality are collected.

3. Ability to track progress on nutrition-sensitive agriculture

Addressing nutrition through agriculture is now high on agendas, and substantial investments are being made in "nutrition-sensitive agriculture" – for example, $19 billion were committed by many donors and governments in 2013 at the G8 meetings (Government of UK 2013). Yet targets and benchmarks in the agriculture sector for improved nutrition are largely absent. Effects of these investments need to be monitored on food – the agriculture and food sector's main,

[16] "The relationship between the prevalence of undernourishment and the percentage of preschool children who are stunted is quite weak. ($R^2 = 0.28$)" (FAO 2013)

unique contribution to nutrition. A consensus view is that "Food and agriculture policies can have a better impact on nutrition if they monitor dietary consumption and access to safe, diverse, and nutritious foods." (Key Recommendations for Improving Nutrition through Agriculture). In the absence of such indicators and targets, it will be difficult to capture how "nutrition-sensitive" investments are indeed contributing to improved nutrition.

Overall, indicators on access to adequate nutritious food and dietary quality would enable better-informed policy options to improve food security and nutrition. If collected over time, they would also allow for an improved evidence base of how agriculture and food policies and programs can affect nutrition. Monitoring data do not guarantee policy solutions; they could lead to a variety of responses in various sectors, and may not necessarily lead to immediate action. But without basic information on the food situation and what people are eating, any efforts to address food insecurity and malnutrition have a major blind spot. The following section proposes examples of indicators that could help to fill the information gaps on food.

Global monitoring of access to adequate nutritious food and diet quality

Tracking "access to adequate food all year round" is a deceptively simple idea. It is well recognized, though, that no single indicator will be able to capture all aspects of it. In 2013 for the first time, FAO's SOFI included a suite of 30 indicators, meant to capture various aspects of food insecurity. This in itself indicates a shift away from relying only on the undernourishment indicator as a proxy for food security. Still, few indicators in the new suite shed light on the availability, access, and dietary consumption of healthy diets. To fill this information gap, indicators could be monitored at four levels: national-level food availability, local-level food

environments, household-level food access, and individual-level diet quality. The following sections explore current and possible indicators at each of these levels, summarized in Table 2.

Table 2: Possible indicators of adequate food

Indicators	*Notes*
National-level food availability	
– % Non-starches	Negatively correlated with stunting (FAO 2013) but not correlated with obesity (Remans et al. 2013)
– Fruit and vegetable availability	Falls below need in most countries in the world (Siegel et al. forthcoming)
– Sugar availability	Significantly associated with diabetes prevalence (Basu et al. 2013)
– Availability of other food groups	Could be useful if recommended amounts were established
Local-level food environments	
– Cost of healthy diets	Important information but insufficient: would need disaggregation by food group to go beyond status quo policy conclusion (increase incomes and decrease price of food generally)
– Relative prices of different food groups	Could show which components of the food basket are causing healthy diets to be less affordable
– In some locales: Community-level production diversity	May be useful where a majority of food is produced and consumed locally
– In some locales: Indicators of obesogenic food environments (see Swinburn et al. 2013)	May be useful where markets are easily accessible
Household-level food access	
– Food Insecurity Experience Scale (FIES)	An informative complement to dietary data; the experience of food insecurity can only be gained from household survey data (Ballard et al. 2013)
Individual-level diet quality	
– Women's dietary diversity score (WDDS)	Validated for nutrient adequacy (Leroy et al. forthcoming); cut-off being developed
– Botanical dietary variety	May be associated with reduced risk of chronic disease
– Proportion of ultra-processed foods in the diet (Monteiro)	A lower proportion may be associated with improved dietary quality and reduced risk of chronic disease

National-level food availability

At national level, data are available that could be used in a more informative way to illustrate the general picture of food availability in a country. Ideally, national level data would be used to estimate the per capita supply of food groups, to understand whether it is theoretically possible for all people in a country to access adequate food as recommended in dietary guidelines. They could not explain the reasons for a supply gap or excess, but could show whether there is one. For example, 400/grams/day per capita of fruits and vegetables are recommended as a minimum intake for healthy diets (WHO and FAO 2003). Two recent analyses show that fruit and vegetable availability falls below dietary need in most countries in the world (Siegel et al. forthcoming, Keats and Wiggins 2014). WHO also recommends limiting salt to less than 2g per day (WHO 2012) and has drafted a guideline to limit sugar consumption to 5% of dietary energy intake (WHO 2014). National-level sugar availability appears to be significantly associated with diabetes prevalence (Basu et al. 2013). For other food groups, there is currently no international recommendation for amounts needed.[17]

Currently, the national-level food indicators reported in FAO's *State of Food Insecurity in the World 2013* include the traditional indicators – dietary energy supply, protein supply, and undernourishment – as well as two indicators related to the type of food available: share of dietary energy supply derived from cereals, roots and tubers; and average supply of protein of animal origin (FAO 2013). The latter is difficult to interpret, since there is no defined optimal

[17] Partly this is because the nutrients in various foods are substitutable between food types. The health benefits from plant foods such as fruits and vegetables, however, probably come primarily from their phytonutrient content rather than micronutrient content, which is why they are not substitutable. While there is no recommended amount of legumes and nuts, greater consumption of them is associated with reduced all-cause mortality in high-income countries (Bao et al. 2013). There is no recommendation on an optimal amount of animal-source food consumption, which may depend on lifecycle stage, as well as the type of animal-source food (milk, meat, fish, etc.).

value, and it is not clear whether increases are positive or negative.[18] The former may reflect nutritious food access to some extent, because as the share of energy supply from starches goes down, the proportion of stunting also goes down (R^2=0.46) (FAO 2013). It is probably not a sufficient indicator, however, of access to adequate nutritious food for several reasons. First, it could indicate the likelihood of consuming diets excessive in animal-source food, sugar, and fat, because these are all also highly correlated with a lower proportion of energy supply in starches (FAO 2013). Indeed, the indicator is not significantly correlated with obesity rates (Remans et al. 2013). Second, appropriate policy responses would be difficult to define, since it does not indicate which parts of the diet are relatively more or less accessible.

National-level indicators of nutritious food availability are highly feasible to report, since FAO collects food availability data annually. Using FAO's food balance sheets, both the per capita supply and estimated prevalence of inadequate consumption (or overconsumption) of the various food groups could be calculated. Furthermore, the same technique used to calculate undernourishment could be adapted to calculate the prevalence of people not able to consume recommended amounts of various food groups. National food availability data cannot provide direct information on dietary quality (which requires survey data), but could provide useful information underlying the food access and dietary consumption patterns.

[18] An increase in animal protein availability might be consumed primarily by the wealthier, for whom increases may be negative for health, instead of by the poor, for whom increases may be positive for health.

Local-level food environments

Of course, national-level data can mask significant regional and local differences. The local level is most significant for eating behaviors because it is where households interact with the market: it is where prices, convenience, advertising, and norms have the most influence on consumption behavior. Ideally, local or community-level data would be collected on availability, affordability, and convenience of various food groups or food types.

A promising type of indicator is of affordability of adequate nutritious diets.
Various tools have been developed that could measure cost of adequate nutritious diets, such as Save the Children's "Cost of Diet" tool which results in an indicator "percent of households who cannot afford a balanced diet" (Chastre et al. 2009). Recent research using a different methodology found that on average, based on all available studies globally, healthy diets cost an average of US$21/week more than unhealthy alternatives (Rao et al. 2013).[19] Such data, though useful, would result in policy implications no different than the status quo: raise incomes, and lower overall food prices. In order to know *which* foods are out of reach, any data on the cost of a nutritious food basket should be able to be disaggregated into different food groups of public health significance (e.g. grains, fruits and vegetables, legumes and nuts, milk, other animal-source foods, ultra-processed foods).

Currently, local-level data on market prices are regularly compiled and reported only for staple grains (WFP VAM). The techniques used to gather and report these data might be possible to

[19] A majority of studies were from high-income countries, but the authors note that results were similar between high-income and lower-income countries.

expand to other foods as well. Quality of existing market price data collected by ministries of agriculture is probably highly variable. Methods for aggregating data and coming to a price representing the whole food group need to be developed, possibly taking cues from the minimum food basket methodology.

Other community-level food environment indicators have been developed in high-income countries to reflect "obesogenic" food environments (Glanz 2009, Swinburn et al. 2013). These types of indicators may be increasingly relevant globally. In less urban, more agricultural locales, production diversity may be a useful local indicator: one study in Kenya showed that community-level production diversity was associated with greater household dietary diversity (Remans et al. 2011).

Household-level food access

Household survey data is needed for information on food consumption and the direct experience of food insecurity. A limitation of household surveys is that they are usually not done every year, so cannot be used for yearly monitoring or indices. Ideally, household-level data would be collected on experiential measures that ask household respondents directly about food insecurity-related feelings or behaviors (such as, did anyone in the household go to bed hungry in the last month). Currently, such an experiential scale has been validated for all of Latin America (FAO 2012). The Food Insecurity Experience Scale, developed by the FAO Voices of the Hungry project, is based on the Latin American scale and earlier similar scales (Coates et al. 2006, Radimer et al. 1990), and is being piloted in Gallup World Poll in 2014 (Ballard et al. 2013). Certain indicators of household consumption (such as the Food Consumption Score and

Household Dietary Diversity Score) are validated for calorie consumption (Leroy et al. forthcoming) and have been shown to be correlated with child nutritional status (Tiwari and Skoufias 2013). There may be possibilities to improve household-level consumption data through Household Consumption and Expenditure Surveys, but the best data for dietary quality is at the individual level.

Individual-level diet quality

Dietary intake is closely linked to nutrition, health, and development outcomes. Along with food access data, dietary quality information would be important to enable targets or benchmarking for nutrition-sensitive policies and programs, particularly in the agriculture sector. Some countries measure dietary quality in national surveys, and FAO is undertaking an effort to create a global database of dietary intake data. Currently, however, there are no globally-comparable indicators of diet quality collected.[20] Ideally, diet quality indicators would reflect how closely diets align with dietary recommendations (which are based on both nutrient adequacy and epidemiologic data). Furthermore, ideal diet quality indicators would be easy to collect, analyze and interpret. Scores with cutoffs for adequate values may be the kind of dietary data most easily interpretable by policymakers.

Individual dietary diversity scores, in particular the women's dietary diversity score, aim to reflect nutrient adequacy. They are highly feasible to collect and have been developed and validated for adequacy of nutrients and calories (FAO 2011, Leroy et al. forthcoming). A

[20] While indicators of young child diet quality are very recently collected (e.g. Minimum Acceptable Diet, WHO 2008), these are primarily reflective of care practices, and not reflective of diets in the general population.

limitation of dietary diversity scores is that while they correlate well with nutrient adequacy, they do not have a strong or meaningful association with overconsumption or chronic disease. As that is increasingly a problem with dietary quality, additional or other indicators are needed. Botanical dietary variety (the number of plant foods consumed over a specified recall period) could be explored as an indicator of present and future chronic disease risk. Another possible indicator, used in research in Brazil where diets are rapidly changing, is the proportion of ultra-processed foods in the diet (Monteiro 2013). The USDA monitors dietary quality in the U.S. with an indicator, the Healthy Eating Index, which is designed to measure how well diets match the Dietary Guidelines for Americans, and measures both "adequacy" and "moderation" components (Kennedy 2008). This sort of indicator could be adapted for global use.

Conclusion

Current global indicators, data, and targets are insufficient to monitor access to adequate food and dietary quality. This data gap results in an inability to analyze major causes of malnutrition, or to track progress related to nutrition-sensitive agriculture investments. Most importantly, it precludes accountability toward a goal of universally-agreed importance: that all people, at all times, have access to adequate sufficient, safe, and nutritious food for a healthy and active life (re-articulated in the UN Zero Hunger Challenge as "100% access to adequate food all year round").

What is monitored at global scale has consequences. The Millennium Development Goals have shown the importance of well-chosen indicators: "the MDGs have had enormous communicative power. Once the goals were defined and the targets set, they began to shape the way that

development was understood" (Fukuda-Parr et al. 2013). In the post-2015 development agenda, the global community now has an opportunity to align indicators better with ideals for food access – especially since it is increasingly clear that poor diets are a major cause of all forms of malnutrition, and food access is a major contributor to poor diets.

Current global measurement of food access was made for a different world, 50 years ago. Then, the challenge was *food shortage*. Now, the major problem in most places in the world is *nutritious food shortage* (World Bank 2014). Given current food availability data, it is theoretically possible for everyone to consume *enough*, but it is impossible for everyone to consume *nutritious diets*. The needed data and indicators to reflect this new food challenge are not monitored yet; and some indicators probably need to be developed (see Table 2). This should not prevent the inclusion of indicators in global monitoring frameworks now.[21] One lesson from history is that the core data collected and published can change radically, resulting in a much better understanding of the problems that need to be tackled. Thirty years ago, the collection and reporting of data on anthropometry and infant feeding behaviors was a daunting challenge, but one that was overcome, with enormous impact regarding how the data have been used.

The challenge now is to update the way "food" is monitored globally. Given the current triple burden of malnutrition, data and indicators need to reflect access to *nutritious* food, along with dietary quality. It may take time to get the ideal indicators, but analogous to how indicators of

[21] Reflecting on the inclusion criteria for MDG indicators, which specified that data should be presently available, one scholar has observed that "It may be the case that issue areas that have been underemphasized or marginalized may be precisely the ones for which data is lacking. To then use this lack of data to exclude these issues from the goal setting process is to compound the marginalization." (Fukuda-Parr et al. 2013)

infant feeding evolved, there are feasible indicators available now (see Table 2). Indicators such as women's dietary diversity and the cost of a nutritious diet would already be informative, and can start to highlight the issue of nutritious food as worthy of global attention. Collecting and reporting better food indicators would give policy-makers the necessary information to weigh potential policy and program options, particularly in the agriculture and food sector. Indicators aligned with the vision of "adequate food for all" are vital to action and accountability toward that ideal.

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