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Seeking Indicators of Healthy Diets

It Is Time to Measure Diets Globally. How?

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It is time to measure diets globally. How?

Executive summary

At a time when multiple forms of malnutrition exist 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. Dietary risks are the *number one risk factor* globally for deaths and disability-adjusted life-years (DALYs) lost (GBD Risk Factors Collaborators 2015), and also within "developing" countries (IHME 2013). Inadequate diets are also a major contributor to child undernutrition, which causes 45% of child deaths (Black et al. 2013). Routinely collected, globally comparable information on diet quality is needed to understand dietary trends, help to create awareness and inform policies to improve diets and health outcomes.

The Gallup World Poll is a feasible vehicle for monitoring diet quality. Doing so will require development and validation of new indicators. This effort will not attempt to measure diet quality comprehensively, such as through dietary intake surveys and diet quality indexes. Rather, we are striving for indicators that provide a strong enough barometer of diet quality for monitoring and policy action.

A review of definitions of healthy diets and existing tools for measurement identifies the top priorities for measurement. Taking into consideration international and national dietary recommendations, epidemiologic meta-analyses and well-vetted dietary patterns, several salient themes stand out. Firstly, the guidelines are all founded on the same general principle that *a healthy diet protects against all forms of malnutrition and NCDs*. Second, while the exact make-up of a healthy diet can vary by cultural context and other factors, basic principles of what constitutes a healthy diet are common across contexts. The two most indisputable elements of healthy diets across definitions and studies are:

- Consumption of abundant, diverse plant foods (including fruits, vegetables, whole grains, legumes and nuts)
- Low consumption of ultra-processed foods (including sugar-sweetened beverages, processed meats and other packaged snack foods)

These common themes of a healthy diet are universally important across regions and countries, including those in which diets are rapidly transitioning. Therefore, these dietary components are those which a global diet quality module should seek to measure.

How to measure these proposed elements of healthy diets will require further discussion and development. No existing indicators are ready to be scaled up, although there are many examples of relevant survey questions. In general, available methods include open recall,

screeners such as a short food frequency questionnaire or a behavioral questionnaire about specific foods and preference questions. Screeners are most likely the most appropriate method.

In conclusion, the “why, when, who and what” to measure is relatively clear, while the “how” requires more discussion and work to be done. It is clear why we need to measure diets. There is no reason to delay work on this topic; after decades of relative inaction, its time has come. Gallup World Poll is an attractive option for monitoring of diets globally. As for what to measure, we have chosen the two elements of diet for which there is overwhelming agreement among definitions, guidelines and evidence on diets and health outcomes: diverse plant foods and ultra-processed foods. Multiple methods exist for measuring these elements of diet, but with varying levels and types of validation, laying out no clear model to follow. How the nutrition community moves forward to monitor diet quality will require innovation and collaboration. We envision enabling scholars and policymakers to start using cross-country diet-quality monitoring data routinely, filling a decades-old gap in basic information about nutrition.

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Acronyms

DALY Disability-Adjusted Life Year
DASH Dietary Approaches to Stop Hypertension
DGAC Dietary Guidelines Advisory Committee
DHS Demographic and Health Surveys
DQI Diet Quality Index
FAO Food and Agriculture Organization of the United Nations
FBDG Food-Based Dietary Guidelines
FFQ Food Frequency Questionnaire
FIES Food Insecurity Experience Scale
GIFT FAO/WHO Global Individual Food Consumption Data Tool
GBD Global Burden of Disease
GDD Global Dietary Database
GWP Gallup World Poll
HCES Household Consumption and Expenditure Survey
HEI / aHEI Healthy Eating Index/Alternative Healthy Eating Index
ICN2 International Conference on Nutrition 2
INDDEX International Dietary Data Expansion Project
IYCF Infant and Young Child Feeding
MICS Multiple Indicator Cluster Surveys
MDD-W Minimum Dietary Diversity — Women
NCDs Noncommunicable Diseases
NHANES National Health and Nutrition Examination Survey (USA)
NUGAG Nutrition Guidance Expert Advisory Group
PUFA Polyunsaturated Fatty Acids
SDG Sustainable Development Goals
SSB Sugar-Sweetened Beverages
STEPS WHO STEPwise Approach to Surveillance
SUN Scaling Up Nutrition
UPF Ultra-Processed Food
VoH Voices of the Hungry Project
WHO World Health Organization of the United Nations

Introduction

When most people — including policymakers and the general public — think of "nutrition," diet is the concept that most immediately comes to mind. Diet is defined as what a person habitually eats. Beyond the immediate intuitive connection between diet and health, public health research has shown that diet has a large causal impact on nutrition and health. Diet supplies essential nutrients, as well as other beneficial and harmful substances, to the body.

The coexistence of multiple forms of malnutrition, and the rapid rise in non-communicable diseases (NCDs), is unquestionably related to poor diets and the types of food people can access. Overall, approximately half the planet is affected by malnutrition — stunting affects 165 million children, micronutrient deficiencies affect an estimated 2 billion people and overweight/obesity affects an estimated 1.9-2.1 billion (GBD Risk Factors Collaborators 2015). In most low- and middle-income countries in the world, obesity NCDs co-exist with undernutrition. It is no longer a world of "rich, fat" and "poor, undernourished" countries: among 80 countries identified as "high stunting-burden" (child stunting rates of 20 percent or higher[1]), over a third have adult overweight/obesity rates of over 30%, and 14 have overweight/obesity rates of 50% or greater. 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 (IDF 2011). These statistics show that obesity and related chronic disease are not only problems for wealthy nations or people. Indeed, 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). The most prevalent non-communicable diseases (cardiovascular disease, stroke, diabetes, cancer) are attributable partly or mainly to diet.

Dietary risks are the *number one risk factor* globally for deaths and disability-adjusted life-years (DALYs) lost (GBD Risk Factors Collaborators 2015), and also within "developing" countries (IHME 2013).[2] By 2020, it is estimated that nearly 75% of deaths and 60% of DALYs will be attributed to NCDs, mostly due to dietary or diet-related causes (Lim et al., 2012). In addition to that, inadequate diets are a major contributor to child undernutrition — which is the number one cause of child death.

Given the massive importance of diets to public health, disease burdens and nutrition of people of all ages, classes and genders, **it is an almost unbelievable data gap that diet quality is not monitored** across countries, nor within most countries. Where dietary intake data are collected, they are not easily available[3] or "digestible," and they are not necessarily nationally and/or regionally representative.

Why are data on diet quality needed?

The global community has recognized the importance of assessing diet quality in addition to food quantity in terms of calorie availability, but diet quality is not yet monitored. Measurement is

[1] Horton et al. (2010) used a cut-off of stunting rates of 20 percent or higher to identify high stunting-burden countries.
[2] The calculation of dietary risks to DALYs 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.
[3] Two initiatives are working to address the gap in publicly available dietary intake data: The FAO/WHO Global Individual Food consumption data Tool (GIFT), and the Global Dietary Database (GDD) at Tufts University.

critical to understand what dietary gaps exist, in what geographies and seasons and in what populations.

While the nutritional status of women of reproductive age is recognized as essential to women's rights and to stopping the intergenerational cycle of malnutrition, no indicators of women's diets are collected across countries. MDD-W has been developed and a strong argument could be made to include it in the DHS, although currently DHS does not collect any dietary data for people over age two years. Data on minimum dietary diversity in children age 6-23 months is now available for 60 countries, among which on average only 36% of young children are fed four or more food groups (IFPRI 2016). This abysmally low figure reflects either inadequate food access or care practices or both.

Poor diet quality is correlated with child undernutrition and slower growth (Arimond and Ruel 2004). Child undernutrition causes 45% of child deaths, by far the largest cause of death among children under age five (Black et al., 2013). Interestingly, however, we don't know what proportion of child undernutrition is due to poor diets — either the children's own diets, or their mothers', which directly affects a child's own nutrition *in utero* and during lactation. We don't know because there are multiple causes of undernutrition, and data on child and maternal diets has not been routinely collected.

Information on dietary quality of the population in general, and women and children in particular, could enable better-informed responses to poor quality diets. If collected over time, these indicators would also allow for an improved evidence base of how dietary trends are related to nutritional status and health outcomes. They could also provide evidence for large scale effects of food and nutrition policies.

Mainly, dietary data are needed to understand the causes of malnutrition, and to enable policy and programmatic action to address them. This is true for both undernutrition and obesity and NCDs. Monitoring data do not guarantee policy solutions; the data could lead to a variety of responses in various sectors, and may not necessarily lead to immediate action. Without basic information on what people are eating and the quality of diets, however, efforts to address malnutrition and NCDs have a major blind spot.

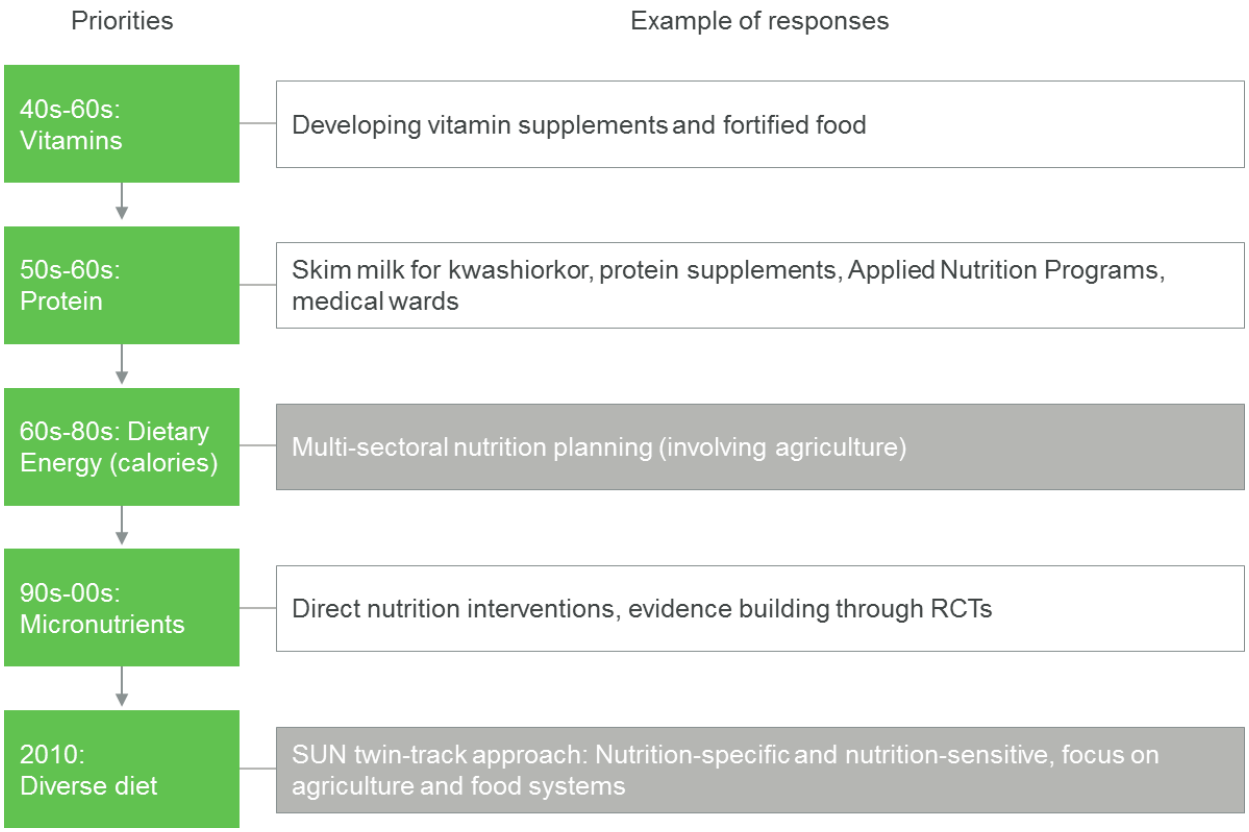
Why now? Why hasn't it been done before?

The nutrition community simply has not yet focused in a major way on this particular gap. At the moment, there is a great amount of interest and enthusiasm in agriculture, food systems and nutrition. These linkages have not been a focus since the 1970s.

A brief history of the salient priorities in nutrition shows that this is the first time that attention is turning toward diets and healthy, sustainable food systems (Figure 1). In the 1970s, the global nutrition community worked on multisectoral nutrition programming, with agriculture in particular because the major priority for nutrition was to increase access to adequate calories, which overlapped with the Green Revolution era priorities to increase global food supply. When multisectoral nutrition planning largely failed to generate lasting collaborative partnership or results, the nutrition community moved into a period sometimes called "nutrition isolationism" (Levinson and McLachlan 1999). In this period from the late 1980s until about 2010, the international nutrition community focused on research and actions that did not require multisectoral collaboration. During this recent era, nutrition worked on coming to consensus on the causes of malnutrition (UNICEF 1990); developing the evidence for the dire consequences of malnutrition (Pelletier et al., 1995); the epidemiology of vitamin and mineral deficiencies and

advocacy around “hidden hunger”; advocacy for breastfeeding and development of guidelines for optimal infant and young child feeding (WHO 2002); and the evidence base for direct nutrition interventions (Lancet Series on Maternal and Child Undernutrition 2008). The prevalence, causes and consequences of poor diets were not part of the evidence base. With the food price crisis of 2008, and the Scaling Up Nutrition (SUN) movement starting in 2010 — which called for “nutrition-sensitive” development particularly in agriculture — food came back onto the agenda.

Figure 1. A brief history of the salient priorities in global nutrition



Source: Adapted from World Bank 2014

In the last two decades, great strides have been made in the monitoring of nutritional status, infant and young childcare practices and health risk factors; infectious disease prevalence is also well-monitored.[4] 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 — we are stuck where we left off with food in the 1970s. Even recent advances in food insecurity measurement, most notably the FIES taken on by Gallup in partnership with FAO in 2014, mainly reflect people’s perception of their own access to adequate food, without giving

[4] Nutritional status started to be monitored in the mid-1990s with the start of the Demographic and Health Surveys (DHS) in countries around the world. Indicators of health status and care practices have evolved over time with advances in knowledge, data, and research. Even anthropometric indicators have evolved: in 2013, UNICEF’s flagship report *State of the World’s Children* began reporting the prevalence of child obesity, as data become available in more countries (UNICEF 2013).

information about the nutritional quality of diets they are eating. Indicators of diet quality are basic data that are, to date, missing in the world's ability to identify causes of malnutrition. In short, diet quality simply has not been the focus of global nutrition in recent decades, and now the time is ripe to move forward on this neglected agenda. In keeping with this first reason is a second correlate: there is no clearly stated, widely endorsed global consensus on a definition of diet quality. The closest we currently have is a "Healthy Diet Fact Sheet" published by WHO, the most salient points of which are excerpted the review section below. Because of this gap, the ICN2 included a recommendation: "Develop, adopt and adapt, where appropriate, international guidelines on healthy diets." (Recommendation 13, ICN2 Framework for Action 2014).

It should be noted that there *is* clarity on two areas of diet quality: *nutrient* requirements (WHO and FAO 2004) and optimal diets for infants and young children under the age of two years (WHO 2008). These, again, reflect the science and priorities of the nutrition community over the last several decades. Basically, there is strong consensus within the field of nutrition on IYCF, but there is not the same level of definition/agreement/consensus on what a healthy diet is for the population in general.

This project calls for the nutrition community to come together around the importance of measuring diet quality, and to find ways it can be measured. This paper seeks to identify elements of diet that are emphasized across widely-used definitions and across countries, as well as in the scientific literature, as key elements of diet quality that could potentially be monitored. It also lays out ways to measure these key elements, that would be feasible to incorporate into Gallup World Poll as a survey vehicle.

What are the options for collecting information on diet quality?

- The DHS and MICS collect no dietary data for adults. DHS includes the only dietary information collected across a (still relatively small) range of countries: the "minimum acceptable diet" indicator for young children, which is primarily an indicator of care practices in children under age two years. These would be potentially useful vehicles for collecting dietary data, and given the importance of diet to health, it would seem very reasonable for them to incorporate dietary indicators. So far, there are advocacy efforts for MDD-W, but the process to change these surveys is slow.
- Household consumption and expenditure surveys (HCES) do not collect data at the individual level, and therefore by definition cannot collect dietary data; even if diets were to be estimated from household data, HCES currently vary widely in the comprehensiveness of their food lists and the reliability of the data collected.[5]
- National dietary intake surveys are expensive and infrequent. They have not previously been compiled globally, but are now being compiled in two initiatives: The FAO/WHO Global Individual Food Consumption Data Tool (GIFT) and the Global Dietary Database (GDD) at Tufts University. While these are rich sources of information on dietary intake, they are not appropriate for monitoring diet quality in the short term. The United States conducts a nationally representative dietary intake survey annually (NHANES), but by global standards, this is exceptional. In most countries, dietary intake data is collected much less frequently (on the order of every five to 20 years), if at all, and sometimes is not nationally representative.

[5] Efforts are underway to try to improve the relevance and reliability of HCES for nutrition, primarily through the International Dietary Data Expansion Project (INDDEX) at Tufts University: **http://inddex.nutrition.tufts.edu/project-overview**

- The WHO STEPwise Approach to Surveillance (STEPS) is a standardized method for collecting, analyzing and disseminating data on NCD risk factors (including some of those in the WHO Global Action Plan for the Prevention and Control of NCDs 2013-2020) in WHO member countries. Comparable country estimates are slated to be published in the Global Health Observatory.[6] However, data from STEPS surveys are country owned and not always shared.
- School-based surveys could be implemented to collect information on diets of children.
- Because none of these options are currently functional for monitoring diet quality in the general population, there is a need to explore monitoring diet quality through another regularly administered survey effort at the global scale. This is the reason for exploring the collection of diet quality information through Gallup World Poll.

Why Gallup World Poll?

By Andrew Rzepa

As part of the FAO 's "Voices of the Hungry Project," the Gallup World Poll collects data on the Food Insecurity Experience Scale (FIES) which is used as a measure of food insecurity to inform SDG indicator 2.1.2. The FIES survey module collects information on experiences related to food insecurity, from worry about obtaining food, through changes in the choice of foods, to actual reduction of quantity — all related to not having enough money or other resources to obtain food. It does not provide information on the quality of diets people are consuming.

The proposed global measurement of diet quality thus seems the natural successor to "Voices of the Hungry," and dovetails well with the project. The team is determined to create a similar impact and help harmonize a standard and common approach to facilitate discussion and more importantly policy and action to tackle this global problem.

With Gallup and World Poll team members taking a lead in the meeting, should a diet quality instrument be validly developed following the meeting, a clear opportunity will exist on how to take the instrument from "out of the laboratory" and into the field, in a credible and timely way. This element of "design with intent and purpose" means there is an opportunity for rapid upscaling in potential future phases of the project.

In 2005, Gallup launched the World Poll, an unprecedented 100-year, self-funded effort to collect high-quality data worldwide with a consistent methodology that allows Gallup to annually cover at least 98% of the population aged 15 and above each year. Today, Gallup collects nationally representative surveys in more than 160 countries providing a scientific window into the thoughts and behaviors of the world's adult population.
All samples are probability based and nationally representative[7] with respondents randomly selected at a household level. The questionnaire is translated into all the major languages of each country. Face-to-face surveys are conducted in over 100 countries, with outbound telephone only used in those where telephone coverage represents at least 80% of the population or is the customary survey methodology[8].

[6] Available at **http://www.who.int/gho/ncd/risk_factors/en/**
[7] Exceptions include areas where the safety of the interviewing staff is threatened, scarcely populated islands in some countries, and areas that interviewers can reach only by foot, animal, or small boat.
[8] **http://www.gallup.com/178667/gallup-world-poll-work.aspx**

- The World Poll surveys countries of all income levels. The inclusion of high and middle income countries ensures alignment with the universal nature of the SDGs and the global nature of some of the most significant issues faced in the world.
- The data supports a rights-based approach to development and can be disaggregated by i) individual characteristics (e.g., gender, age, income, religion, race, or ethnicity); ii) economic activity; and iii) geography (e.g., urban and rural).
- There is methodological consistency of sampling, interview methods and question order to allow comparability of results across countries.
- The questionnaire is rigorously translated in over 145 languages; as "work for hire" all translations of 'sponsored' modules belong to the client and can be released — subject to client consent — as a public good in all languages, thereby facilitating adoption by governments, NSOs and NGOs
- Quality control and assurance procedures have been honed over the past ten years, resulting in valid and reliable data every year.
- Sample size is usually 1,000 adult respondents (15 and above). In some large countries, such as India, China and Russia, sample sizes of at least 2,000-3,000 are collected.

The Gallup World Poll is not intended to replace national statistics or other household surveys. One of the key uses of the World Poll is to help develop new frameworks of looking at the world. In close collaboration with its clients and leading experts, Gallup creates the qualitative instrument development framework and subsequently pilots and tests the designed approach. Upon successful development of the instrument Gallup utilizes its streamlined processes to standardize, harmonize and validate the measurement framework which can subsequently be used as a benchmark to monitor progress annually at a national, regional or global level. This approach creates visibility of the issue and helps encourage engagement by providing key interested organizations a robust pre-built framework suitable for national adoption.

Nonetheless, given the paucity of data and patchy quality of national statistics in a number of countries, in some occasions World Poll data is the most credible and reliable data source available. For effective monitoring, policy making and action planning, timeliness is key. Gallup provides its clients data within six to eight weeks of coming out of the field. One example of how GWP has filled a data gap is the Voices of the Hungry Project.

Voices of the Hungry

By Terri Ballard

A key objective of FAO's Voices of the Hungry project (VoH) is to estimate comparable prevalence rates of food insecurity in national populations for more than 140 countries every year. The measure is based on conditions and behaviors reported by adults through the Food Insecurity Experience Scale (FIES) survey module. The responses to eight FIES items, each of which focuses on conditions reflecting limited access to food, are used to compute a measure of severity of the food insecurity status. Individual measures are then calibrated against a common global reference scale of severity, producing prevalence estimates of food insecurity that are comparable across countries and population groups. FIES data have been collected through the Gallup World Poll since 2014 in nationally representative surveys of the adult population in more than 140 countries every year and the **first report with global results** for 2014 has been released. The FIES was piloted in 2013 in GWP surveys in four African countries after carrying out extensive qualitative research in each country to linguistically and culturally adapt the eight FIES items into survey languages. The interviewers receive training yearly on the entire GWP survey questionnaire including the FIES. The FIES takes approximately three to four minutes to

administer in a survey setting. The FIES module is carefully placed within the GWP survey questionnaire to avoid potential bias in the responses in relation to other survey modules. Defining the global reference scale and appropriate methods for calibration of the FIES has been one of the biggest innovation of the Voices of the Hungry project, given the differences in languages, cultures and livelihood arrangements that exist across countries.

Scope

The scope of this project and the definitions of diet quality are meant to reflect the general population; not infants, children or other populations with specific nutritional needs. Gallup World Poll does not collect information on people under age 15, so this proposed vehicle for collecting information on diet quality is limited to adults. That said, any results captured by GWP could be disaggregated by sex and age range within adults. Other methods may need to be developed to capture diet quality of children age two to 14.[9]

Two types of indicators of diet quality:

We can think about capturing diet quality in two ways:

1. An index that comprehensively summarizes dietary intake as compared to dietary recommendations (nutrients, foods, or a combination of both).
2. An indicator that captures a critical aspect of diet quality and is highly correlated with diet quality indexes and/or health outcomes.

The first type requires complete dietary intake data. Dietary intake data on its own does not communicate much about diet quality. It needs to be digested and summarized into something meaningful. A long list of nutrients and foods needs to be condensed into an overall summary, such as the mean probability of adequacy of all selected nutrients, or high scores on an index based on dietary recommendations. This is what diet quality indices (DQI) do. Many of them have been created; many are specifically designed to reflect a specific set of dietary recommendations, e.g. the HEI measures diets compared to the U.S. Dietary Guidelines for Americans, and the Mediterranean Diet Score measures diets compared to the Mediterranean diet (Vandevijvere et al. 2013). As noted above, because there are currently no comprehensive global dietary guidelines, no global diet quality index (intended to measure diets across cultures) has been constructed.

For the second type, there are various ways to think about capturing critical aspects of diet quality. One is capturing the element(s) of diet that account for the greatest proportion of (a) a summation of diet quality such as a DQI, or (b) desirable health outcomes. In other words, if one were to regress all elements of diet quality on a desired outcome like DALYs or overall nutrient adequacy, we would like to measure the one(s) that have the highest r^2. We could come to this conclusion through new analyses, or, more efficiently, through many similar analyses that have been done already — which have led to conclusions such as national and international dietary recommendations, in addition to scientific consensuses. For this reason, definitions and analyses of “healthy diet” are presented below, with the aim of extracting the elements that appear in all or most of them as critical aspects of diet quality.

[9] This age group is partially captured via the Global School-based Health Survey **http://www.who.int/chp/gshs/en/**

Another potential way to think about selecting indicators of diet quality is as instrumental variables — indicators that are not the thing itself, but are highly correlated with the thing we want to capture. Examples of this type of indicator might be dietary preferences, which are not a measure of actual consumption but are highly correlated with it. Why would we potentially be interested in this type of indicator? In case it is more feasible and reliable to measure than the actual construct of interest.

A note here: the element(s) of diet that explain the largest amount of diet quality and/or diet-related health outcomes/NCD prevention, will depend on the context. In principle these elements would be highly prevalent and also variable within the population. Which elements then arise as most critical will depend on dietary patterns and the type and burden of diet-related health outcomes in a given population. It also could depend on demographics (age and sex). For example in some places or populations, high intakes of meat may be one of the biggest dietary problems, where in other places or populations, low intakes of iron may be one of the biggest problems. This introduces the question of whether similar elements of diet arise as top causes of disease/poor diets across contexts; and also whether we need to consider the use of different measures of diet quality in different regions/countries.

In GWP, we will not be able to measure that first type of indicator. The index type measures are based on dietary intake surveys, either time-bound dietary recalls (most often 24 hours), food frequency questionnaires, dietary records or observation. The validity of these methods has been discussed elsewhere (Gibson 2005, Willett 2013). DQI are too time intensive and data intensive to be used in an instrument such as GWP. However, *comprehensive dietary intake data are important to get through other means (e.g. GIFT, INDDEX, GDD).* It is important for knowing what is consumed, dietary patterns and to be able to use in epidemiologic research (e.g. GBD project). It is just not what is possible or desired within this GWP endeavor.

Rather, GWP aims for the second type of measurement: *indicators* of diet quality that reflect valuable information about the quality of diet but do not attempt to measure diet comprehensively.

The purpose of these indicators will be for global tracking of level and improvements or deteriorations in diet quality. The purpose is not for individual assessment — it is not expected that the tool be sensitive enough to use for targeting or diet counseling, but rather for population-level statistics.

Desired characteristics of this proxy diet quality module:

1. Reflective of the most critical pieces of diet quality in the population surveyed (i.e. those that account for the highest variation in total diet quality or health outcomes)
2. Variable
3. Covers both adequacy and moderation
4. Standardized and comparable across cultures (ideally)
5. Simple to administer and score; doesn't require intensive analysis such as conversion of foods to nutrient content
6. Easily interpretable. (Note: this probably implies cut-off points. It is hard for people to interpret continuous scores. We keep in mind that the end-users of data will include policymakers and the public, in addition to public health researchers. Therefore data are needed that can easily be made accessible and understandable to the public.)

How Healthy Diets Have Been Defined

We need to understand how healthy diets have been defined in order to identify elements that are key to "healthy" diets and that could be measured.

Diet quality has been described as having at least two basic components, adequacy (getting enough of certain foods and essential nutrients) and moderation (not getting too much of certain foods or nutrients) (Guenther et al., 2013). Diversity is sometimes considered another component. It is debatable whether diversity is a key component in itself, due to synergistic effects of a variety of foods within a diet pattern, or if it is merely a proxy for adequacy and moderation; as a general concept, diversity implies not too much or too little of any one thing. Proportionality is a fourth concept involved in describing diet quality, which again is closely related to (if not the same as) adequacy and moderation, and comes up most often in food-based dietary guidelines, which recommend more servings of certain foods (e.g. whole grains, fruits and vegetables) than others (e.g. fats and oils). Finally, some descriptions or recommendations of diet quality are sometimes discussed that have more to do with the way food is eaten rather than what is eaten, including enjoyment of food, mindfulness, slow food and community. The current Brazil Dietary Guidelines are an example of where this last element of diet quality is featured.

The following sections describe how diet quality has been defined in ways that represent a significant consensus. This section does not include individual nutrition epidemiology studies, but rather significant efforts that have summarized the body of evidence in nutrition science and epidemiology in order to come to conclusions about broad patterns that the current evidence as a whole shows are related to good health and nutrition. These include United Nations definitions; national dietary guidelines from around the world and two scientific commentaries on the U.S. Dietary Guidelines for Americans in particular; widely-accepted and promoted diet patterns (the Mediterranean diet and DASH diets); and the Global Burden of Disease (GBD) study.

International / UN

The organization with the mandate to provide international guidance on healthy diets is the World Health Organization (WHO). At present, there is not a complete set of clearly endorsed global dietary guidelines. WHO does provide advice on many aspects of diet, however, which appear consistently across various WHO publications and materials.

The WHO webpage on "diet" begins: "An unhealthy diet is one of the major risk factors for a range of chronic diseases, including cardiovascular diseases, cancer, diabetes and other conditions linked to obesity. Specific recommendations for a healthy diet include: eating more fruit, vegetables, legumes, nuts and grains; cutting down on salt, sugar and fats. It is also advisable to choose unsaturated fats, instead of saturated fats and towards the elimination of trans-fatty acids." The WHO *Healthy Diet Fact Sheet* (updated 2015) further defines what is meant by a healthy diet (see box below).

WHO Healthy Diet Fact Sheet *excerpt*

Key fact: A healthy diet helps protect against malnutrition in all its forms, as well as noncommunicable diseases (NCDs), including diabetes, heart disease, stroke and cancer. Overview: Consuming a healthy diet throughout the lifecourse helps prevent malnutrition in all its forms as well as a range of noncommunicable diseases and conditions. But the increased production of processed food, rapid urbanization and changing lifestyles have led to a shift in dietary patterns. People are now consuming more foods high in energy, fats, free sugars or salt/sodium, and many do not eat enough fruit, vegetables and dietary fiber such as whole grains.

The exact make-up of a diversified, balanced and healthy diet will vary depending on individual needs (e.g. age, gender, lifestyle, degree of physical activity), cultural context, locally available foods and dietary customs. But basic principles of what constitute a healthy diet remain the same.

For adults, a healthy diet contains:

- Fruits, vegetables, legumes (e.g. lentils, beans), nuts and whole grains[10] (e.g. unprocessed maize, millet, oats, wheat, brown rice).
- At least 400 g (five portions) of fruits and vegetables a day. Potatoes, sweet potatoes, cassava and other starchy roots are not classified as fruits or vegetables.[11]
- Less than 10% of total energy intake from free sugars which is equivalent to 50 g (or around 12 level teaspoons) for a person of healthy body weight consuming approximately 2,000 calories per day, but ideally less than 5% of total energy intake for additional health benefits. Most free sugars are added to foods or drinks by the manufacturer, cook or consumer, and can also be found in sugars naturally present in honey, syrups, fruit juices and fruit juice concentrates.[12]
- Less than 30% of total energy intake from fats. Unsaturated fats (e.g. found in fish, avocado, nuts, sunflower, canola and olive oils) are preferable to saturated fats (e.g. found in fatty meat, butter, palm and coconut oil, cream, cheese, ghee and lard). Industrial trans fats (found in processed food, fast food, snack food, fried food, frozen pizza, pies, cookies, margarines and spreads) are not part of a healthy diet.
- Less than 5 g of salt (equivalent to approximately one teaspoon) per day and use iodized salt.

Source: WHO Healthy Diet Fact Sheet, September 2015
Note: Please see the original source for references.

Generally these points identified are meant to reflect the areas of diets where evidence is strongest. The available guidance does not address all areas of diets, however, leaving aside several components; for example any recommendations on animal source foods, other than to

[10] Whole grains contain bran and germ of the grain seed; when grains are refined, the bran and germ are removed.
[11] The rationale stated for this recommendation: “Eating at least 400 g, or 5 portions, of fruits and vegetables per day reduces the risk of NCDs (WHO 2003), and helps ensure an adequate daily intake of dietary fibre.”
[12] The “practical advice on maintaining a healthy diet” section states that sugar intake can be reduced by “limiting the consumption of foods and drinks containing high amounts of sugars (e.g. sugar-sweetened beverages, sugary snacks and candies); and eating fresh fruits and raw vegetables as snacks instead of sugary snacks.”

avoid saturated fats and salt which are found in them.[13] It is a mix of food-based and nutrient-based recommendations — as are many dietary guidelines.

It is also unclear how these key elements are decided or by whom. This guidance does not appear in any official WHO publication other than an un-authored web-based fact sheet; it is not signed by any DG for example, nor does it explicitly state that it is WHO guidance. WHO's Nutrition Guidance Expert Advisory Group (NUGAG) Subgroup on Diet and Health is currently tasked to work on recommendations on dietary patterns.

Sustainability in international dialogue around food systems

There is an increasing awareness and emphasis internationally and within UN documents and advocacy that the food system should not only provide healthy diets for all, but that it should also be environmentally and socially sustainable.
FAO has drafted the concept of sustainable diets (FAO 2010) and also sponsored an analysis of food-based dietary guidelines for their sustainability (Gonzalez Fischer & Garnett, 2016). ICN2 uses language about sustainable food system: In the ICN2 Framework for Action, member states committed (among a set of commitments) to *enhance sustainable food systems by developing coherent public policies from production to consumption across relevant sectors to provide year-round access to food that meets people's nutrition needs and promote safe and diversified healthy diet.* FAO is holding a symposium on sustainable food systems for healthy diets to take this forward. Furthermore, the Sustainable Development Agenda is based on sustainability, including around food: SDG Goal 2 is "to end hunger, achieve food security and improved nutrition, and promote sustainable agriculture."

National dietary guidelines

Food-based dietary guidelines (FBDG) generally aim to provide culturally appropriate recommendations for consuming healthy diets. Development of FBDGs is a scientific and political process, incorporating stakeholder views and cultural norms in addition to epidemiologic evidence and dietary intake patterns.

Recently, FAO completed a major update and website launch for their on-line repository for FBDG and associated resources.[14] A team of researchers, including the author, has set out to review these FBDGs for commonalities and differences, in the quest for providing evidence for whether certain themes would be relevant to monitor globally across countries (Arimond et al., in preparation). FBDGs were available on country web pages for 82 countries (five from the Africa region, 15 from the Asia and the Pacific region, three from the Near East region, 32 from the European region, 25 from the Latin America and the Caribbean region and two from North America).

Arimond et al. conclude: "Shaped by their context, national- or regional-level FBDG vary widely *in their specifics*. However, there are many recurring elements and themes, either implicit or explicit (e.g. dietary diversity, balance, proportionality, ensuring adequacy, moderation in some foods/groups)."

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[13] The "practical advice on maintaining a healthy diet" section states that fat intake can be reduced by using vegetable oil (not animal oil), and "limiting the consumption of foods containing high amounts of saturated fats (e.g. cheese, ice cream, fatty meat)." It also states that "In many countries, most salt comes from processed foods (e.g. ready meals; processed meats like bacon, ham and salami; cheese and salty snacks)."

[14] **http://www.fao.org/nutrition/education/food-dietary-guidelines/home/en/**

Some of the recurring themes include the following, sourced from Arimond et al. (in preparation):

Fruits and vegetables

- The single most common message in FBDGs is on fruits and vegetables. 100% of countries include fruits and vegetables in abundance in pictorial representations, and almost all include an explicit message to consume them in their key messages.
- About 1/3 of countries recommend a quantitative **amount** (e.g. 5/day or 400g/day).
- About 1/5 of countries specifically recommend consuming **variety** within fruits and vegetables.
- About 1/6 of countries specifically recommend consuming different **colors** or specific colors (e.g. dark green and orange).
- About 1/10 of countries specifically recommend consuming "**fresh**" fruits and vegetables. Very few countries specifically recommend consuming **local** fruits and vegetables.

Categorization of foods

- There is wide variability in food groupings. Most countries group foods into three to five food groups. The most common set of five groups is: starchy staples, fruits, vegetables, dairy foods and other "protein foods." The most common four group combination is: starchy staples; fruits and vegetables; dairy; other "protein foods." The most common three-group combination is: starchy staples; fruits and vegetables; and "protein foods."
- A majority of countries put fruits and vegetables in two different groups, although a sizeable minority (about 1/3 of countries) groups them together. Few countries include potatoes in the vegetable group.
- There are key messages on legumes and/or nuts in about 2/3 of countries. There is great diversity in how legumes and nuts are presented in graphics and guides. Sometimes they are presented as their own group. More often, they are grouped with "protein foods" (as in the case in North and much of Europe and the Asia Pacific region); with vegetables (in a significant number of European countries); or even with starchy staples (in a third of Latin American countries).
- Globally, there are mixed messages on nuts, with some countries seeming to discourage consumption by grouping them with fats/oils, and other countries encouraging consumption. FBDGs are much more likely to include messages about legumes than about nuts.

Foods to avoid

- Most countries advise to reduce consumption of sugar and salt. Many specifically say to limit consumption of processed foods that are most likely to contain added sugars and salt; but many others do not, leaving their message only at the nutrient level. Several European countries place red meats and/or processed meats in the tip of the pyramid, suggesting moderation of these foods.
- Example from El Salvador: "Avoid eating sugary foods and drinks, chips, sausages, sweets, highly processed foods and canned foods."

- Example from Brazil: “Make natural or minimally processed foods the basis of your diet. Natural or minimally processed foods, in great variety, and mainly of plant origin, are the basis for diets that are nutritionally balanced, delicious, culturally appropriate and supportive of socially and environmentally sustainable food systems. Variety means foods of all types — cereals, legumes, roots, tubers, vegetables, fruits, nuts, milk, eggs, meat — and diversity within each type — such as beans and lentils, rice and corn, potato and cassava, tomatoes and squash, orange and banana, chicken and fish.” And, “Avoid consumption of ultra-processed foods. Because of their ingredients, ultra-processed foods such as salty fatty packaged snacks, soft drinks, sweetened breakfast cereals and instant noodles, are nutritionally unbalanced. As a result of their formulation and presentation, they tend to be consumed in excess, and displace natural or minimally processed foods. Their means of production, distribution, marketing and consumption damage culture, social life, and the environment.”

Sustainability in national food-based dietary guidelines

Four countries have developed dietary guidelines that specifically include sustainability: Germany, Brazil, Sweden and Qatar (Gonzalez Fischer & Garnett, 2016). The United States Dietary Guidelines Advisory Committee recommended that the Dietary Guidelines for Americans include sustainability, but this recommendation was not taken up in the final policy document. Gonzalez Fischer & Garnett (2016) provide a list of general characteristics of diets with low environmental impact that also are consistent with good health. These diets include:

- Diversity
- Based on minimally processed tubers and whole grains, legumes, fruits and vegetables, seeds and nuts
- Meat, if eaten, in moderate quantities and all animal parts consumed
- Dairy products or alternatives eaten in moderation
- Small quantities of fish and aquatic products sourced from certified fisheries
- Very limited consumption of foods high in fat, sugar or salt and low in micronutrients (i.e. ultra-processed foods)
- Tap water in preference to other beverages

U.S. dietary guidelines and alternative views

It is worth spending a moment discussing the U.S. Dietary Guidelines, for two reasons. One, they include one of the most rigorous processes in the world to review evidence in order to inform the final dietary guidelines policy document. Two, they have a significant influence on dietary guidelines and pictorial representations of dietary guidance in other countries. Analogous to how child growth in other countries used to be measured against the U.S. NCHS growth references until the WHO instituted a multicenter study to determine child growth standards in 2006, given the absence of clear WHO or global dietary recommendations, many countries look to the United States as a reference for dietary guidance.

The *Dietary Guidelines for Americans* are created based on a two-part process.[15] Step one is a review of the evidence by a scientific committee, the Dietary Guidelines Advisory Committee (DGAC). The job of this committee is to reflect science in an unbiased review — although the composition of the committee is not immune from criticism as being inherently biased, based on

[15] See “Developing the *Dietary Guidelines for* Americans” for more detail: **https://health.gov/dietaryguidelines/2015/guidelines/introduction/developing-the-dietary-guidelines-for-americans/**

the members' affiliations and research areas. Step two is the development of the actual policy document, the *Dietary Guidelines*, by two federal agencies, the HHS and USDA. In this second stage, the political influence of non-scientists, including in Congress, can significantly modify the guidance included. Therefore, the US DGAC report is distinct from the Dietary Guidelines for Americans, and can be considered more evidence-based than the official guidelines, as it is less politically influenced.

Over the last few decades, scientists concerned with diet quality have occasionally publicly provided alternative views that challenge the *Dietary Guidelines for Americans* in particular. Most recently, the Oldways Common Ground Consensus[16] was a group of leading nutrition and food systems experts that met in 2015 with the intent to reach consensus on points of agreement on healthy eating. The group emphasized that dietary guidelines should come from a "transparent process, beyond politics," and essentially agreed with the 2015 DGAC food-based recommendations. Specifically, they stated:

"The overall body of evidence examined by the 2015 DGAC identifies that a healthy dietary pattern is ***higher in vegetables, fruits, whole grains, low- or non-fat dairy, seafood, legumes, and nuts; moderate in alcohol (among adults); lower in red and processed meats; and low in sugar-sweetened foods and drinks and refined grains.*** *Additional strong evidence shows that it is not necessary to eliminate food groups or conform to a single dietary pattern to achieve healthy dietary patterns. Rather, individuals can combine foods in a variety of flexible ways to achieve healthy dietary patterns, and these strategies should be tailored to meet the individual's health needs, dietary preferences and cultural traditions. Current research also strongly demonstrates that regular physical activity promotes health and reduces chronic disease risk." (Source: 2015 DGAC summary wording)*

A second key point from the Oldways Common Ground Consensus was agreement that "sustainability is essential" and "food can and should be good for human health and good for the planet." This point of consensus supported the 2015 DGAC's inclusion of sustainability in dietary recommendations, for the first time in U.S. history. Of particular emphasis in the DGAC report was the recommendation to consume less meat due to its negative environmental impact; advice which was discarded in the final *Dietary Guidelines for Americans*, after on a decision made in Congress that the *Guidelines* should only include advice based on (presumably immediate) effects on human nutrition.[17]

Similar to the Oldways group, scientists at the Harvard School of Public Health have long perceived the need to provide an alternative to what they feel is flawed advice in the *Dietary Guidelines for Americans*. This alternative is the Harvard Food Pyramid, also known as the Healthy Eating Plate, first created in the 1990s. The Healthy Eating Plate[18] recommends:

- Vegetables and fruits — 1/2 of plate
  - Aim for color and variety. Doesn't include potatoes because of their negative impact on blood sugar.
- Whole grains — 1/4 of plate
  - Whole and intact grains — whole wheat, barley, wheat berries, quinoa, oats, brown rice and foods made with them (such as whole wheat pasta) have a milder impact on insulin than white bread, white rice and other refined grains.
- Protein — 1/4 of plate

[16] **http://oldwayspt.org/common-ground-consensus**
[17] **http://www.foodpolitics.com/2015/12/house-appropriations-bill-affects-2015-dietary-guidelines/**
[18] **http://www.hsph.harvard.edu/nutritionsource/healthy-eating-plate/**

  - Fish, chicken, beans, and nuts are all healthy and versatile protein sources that can be mixed into salads and paired well with vegetables on a plate. Limit red meat and avoid processed meats such as bacon and sausage.
- Healthy plant oils — in moderation
  - Choose healthy vegetable oils like canola, soy, corn, sunflower, peanut and others. Avoid partially hydrogenated oils, which contain unhealthy trans fats. Remember that low-fat does not mean healthy.
- Drink coffee, water or tea
  - Skip sugary drinks, limit milk and dairy products to one or two servings per day and limit juice to a small glass per day.

Adherence to this diet can be measured with the alternative Healthy Eating Index (aHEI). The USDA's Center for Nutrition Policy and Promotion created the Healthy Eating Index (HEI) to measure how well American diets conform to recommended health patterns. The Harvard School of Public Health researchers in the 1990s created an Alternative Healthy Eating Index with a scoring system similar to the USDA index. They compared the two indexes in two long-term studies, and the aHEI performed better for health outcomes.

Diet patterns

DASH diet

The DASH diet, or the Dietary Approaches to Stop Hypertension Diet, is a diet designed to lower blood pressure, promoted by the U.S. National Heart, Lung and Blood Institute.[19] The U.S. National Institutes of Health (NIH) proposed funding to research the role of dietary habits on blood pressure. A multi-center study in the mid-1990s carried out two DASH trials as multicenter, randomized, outpatient feeding studies with the purpose of testing the effects of dietary patterns on blood pressure, and found that it was effective in lowering and controlling blood pressure. Created in the 1990s, at a time when fat reduction was emphasized in nutrition epidemiologic literature, the DASH diet recommends decreased amounts of total and saturated fat and cholesterol. The DASH diet pattern:

- Is based on vegetables, fruits and whole grains
- Includes fat-free or low-fat dairy products, fish, poultry, beans, nuts and vegetable oils
- Limits foods that are high in saturated fat, such as fatty meats, full-fat dairy products and tropical oils such as palm kernel and palm oils
- Limits sugar-sweetened beverages and sweets

DASH Diet recommendations: Number of servings based on a 2,000 calorie a day diet[19]

Food Group	Daily Servings
Grains	6-8
Meats, poultry, fish	6 or fewer
Vegetables	4-5
Fruits	4-5
Low-fat or fat-free dairy products	2-3

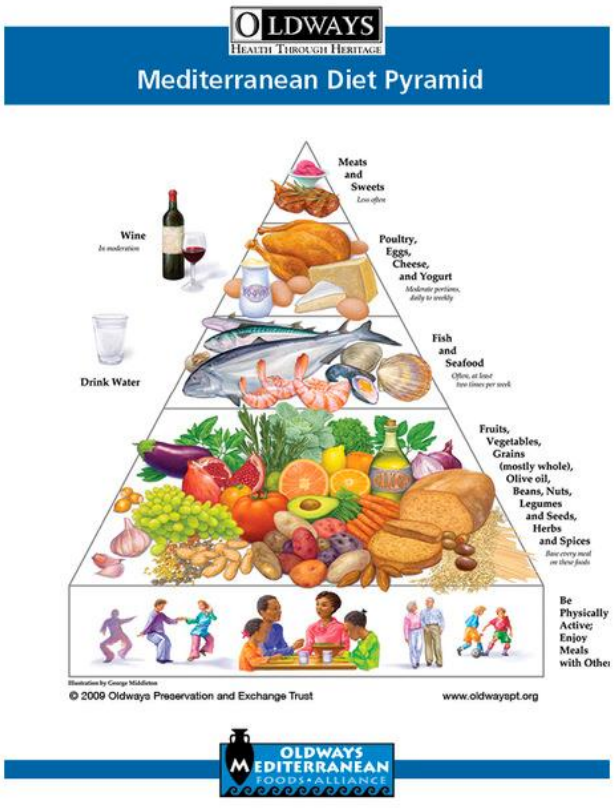
[19] https://www.nhlbi.nih.gov/health/health-topics/topics/dash

Food Group	Daily Servings
Fats and oils	2-3
Sodium	2,300 mg
Nuts, seeds, dry beans, and peas	4-5 weekly
Sweets	5 or less weekly

Mediterranean diet

The Mediterranean diet is characterized by high intakes of fruits and vegetables, use of olive oil and fish and low/moderate red meat intake. It is a diet pattern that has shown positive health outcomes across multiple studies. The Mediterranean Diet Pyramid (pictured below) was created in the mid-1990s, based on traditional diets in Italy, Greece and Crete in the 1960s, “at a time when the rates of chronic disease among populations there were among the lowest in the world, and adult life expectancy was among the highest” (Oldways). This area of the world is what has been called a “Blue Zone,” one of five regions in the world with the highest proportion of centenarians (Buettner 2012). In much research since its development, the Mediterranean diet has been found to be associated with lower risk of disease.

Figure 2. The Mediterranean Diet graphic representation



Source: Oldways http://www.oldwayspt.org/history-mediterranean-diet-pyramid

The Global Dietary Database (GDD) and Global Burden of Disease (GBD) Study

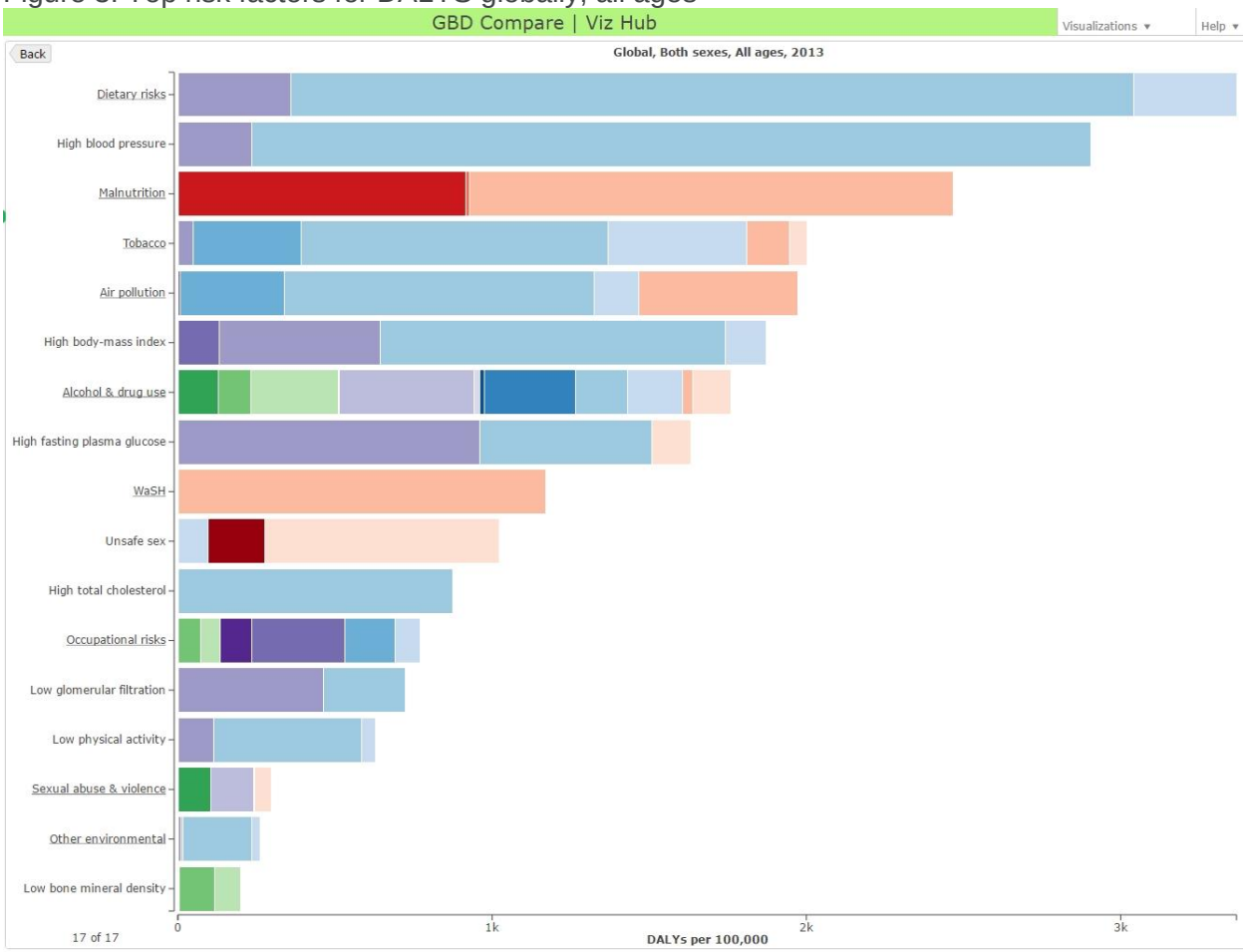
The Global Dietary Database (GDD) compiles over 1,000 dietary intake surveys from 178 countries into a database that can be used for understanding food and nutrient consumption, and to assess the effects of diet on disease.[20] It provides the dietary data used in the Global Burden of Disease (GBD) study, which started in 1990 as a collaborative effort to determine comparable cross-country, regional and global estimates of the burden of diseases, injuries and risk factors.[21] The risk assessments generated in GBD can help to prioritize investment priority areas for policy makers.

The GBD 2013 study found diet to be the number one risk factor globally for deaths and DALYs lost, accounting for dietary 11.3 million deaths and 241.4 million DALYs, as well as in "developed" and "developing" countries (GBD Collaborators 2015). The following Figures 3-5 show the overall risk factors globally and in developing countries. Dietary risks account for the highest burden globally as well as in "developed" and "developing" countries, and child and maternal malnutrition are third globally and second in "developing" countries.

Of note, the only causes of disease associated with dietary risk factors are NCDs: cardiovascular diseases, diabetes and cancers. Child and maternal malnutrition, on the other hand, is modeled for its effect on nutritional deficiencies and communicable diseases. Although current estimation of malnutrition is solely from anthropometry, dietary risks would be a part of that (malnutrition) risk factor category as well, if they could be estimated. In other words, dietary risks would account for an even greater percent of DALYs if they could be modeled as risk factors for nutritional deficiencies as well as NCDs.

[20] **http://www.globaldietarydatabase.org/**
[21] **http://www.healthdata.org/gbd**

Figure 3. Top risk factors for DALYS globally, all ages

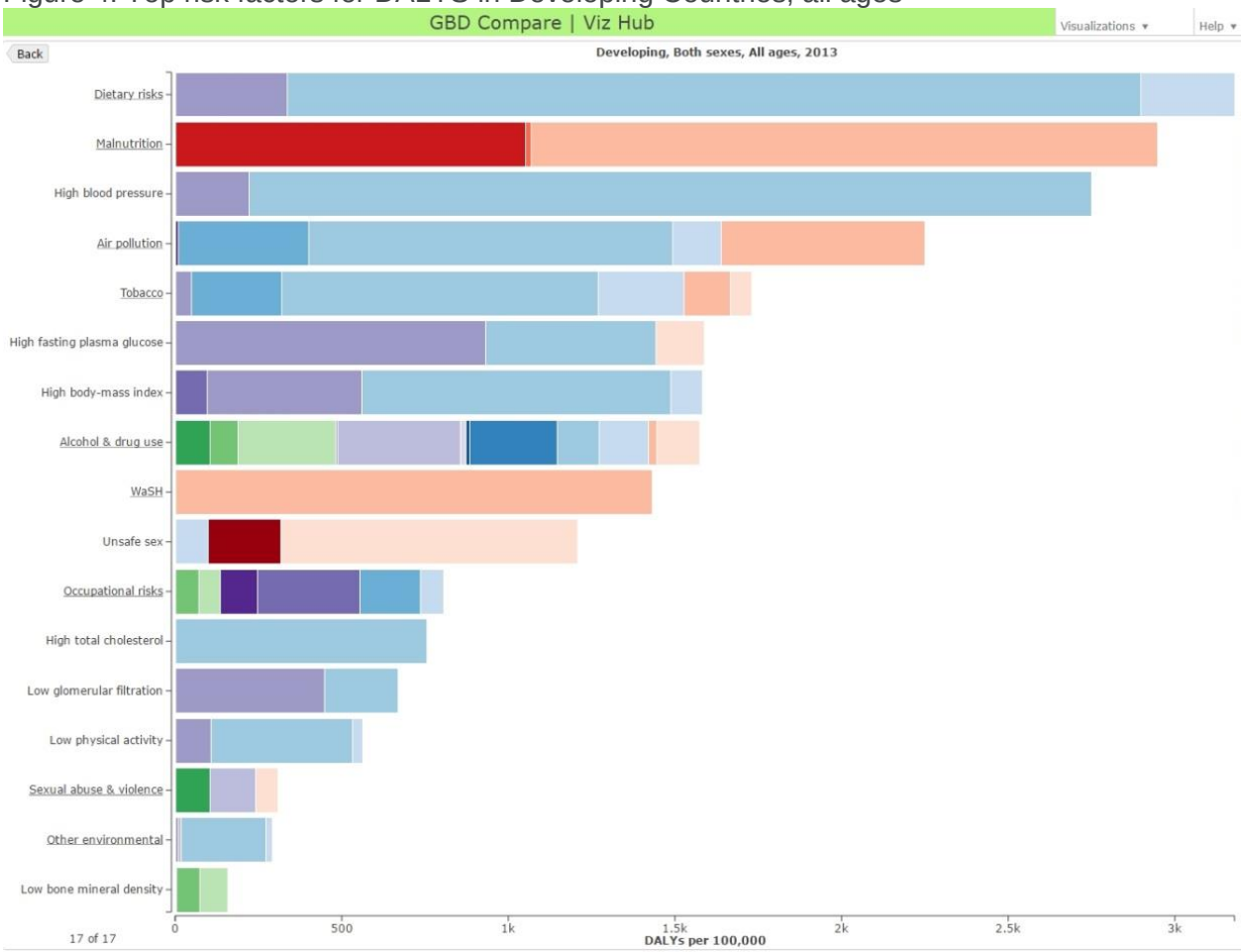


Source: IHME GBD-Compare website, Aug 2016 (2013 data)
A version of this figure is also in: GBD 2013 Risk Factors Collaborators, Lancet 2015, p2299

Color key:

- HIV/AIDS & tuberculosis
- Diarrhea/LRI/other
- NTDs & malaria
- Maternal disorders
- Neonatal disorders
- Nutritional deficiencies
- Other group I
- Neoplasms
- Cardiovascular diseases
- Chronic respiratory
- Cirrhosis
- Digestive diseases
- Neurological disorders
- Mental & substance use
- Diabetes/urog/blood/endo
- Musculoskeletal disorders
- Other non-communicable
- Transport injuries
- Unintentional inj
- Self-harm & violence
- War & disaster

Figure 4. Top risk factors for DALYS in Developing Countries, all ages



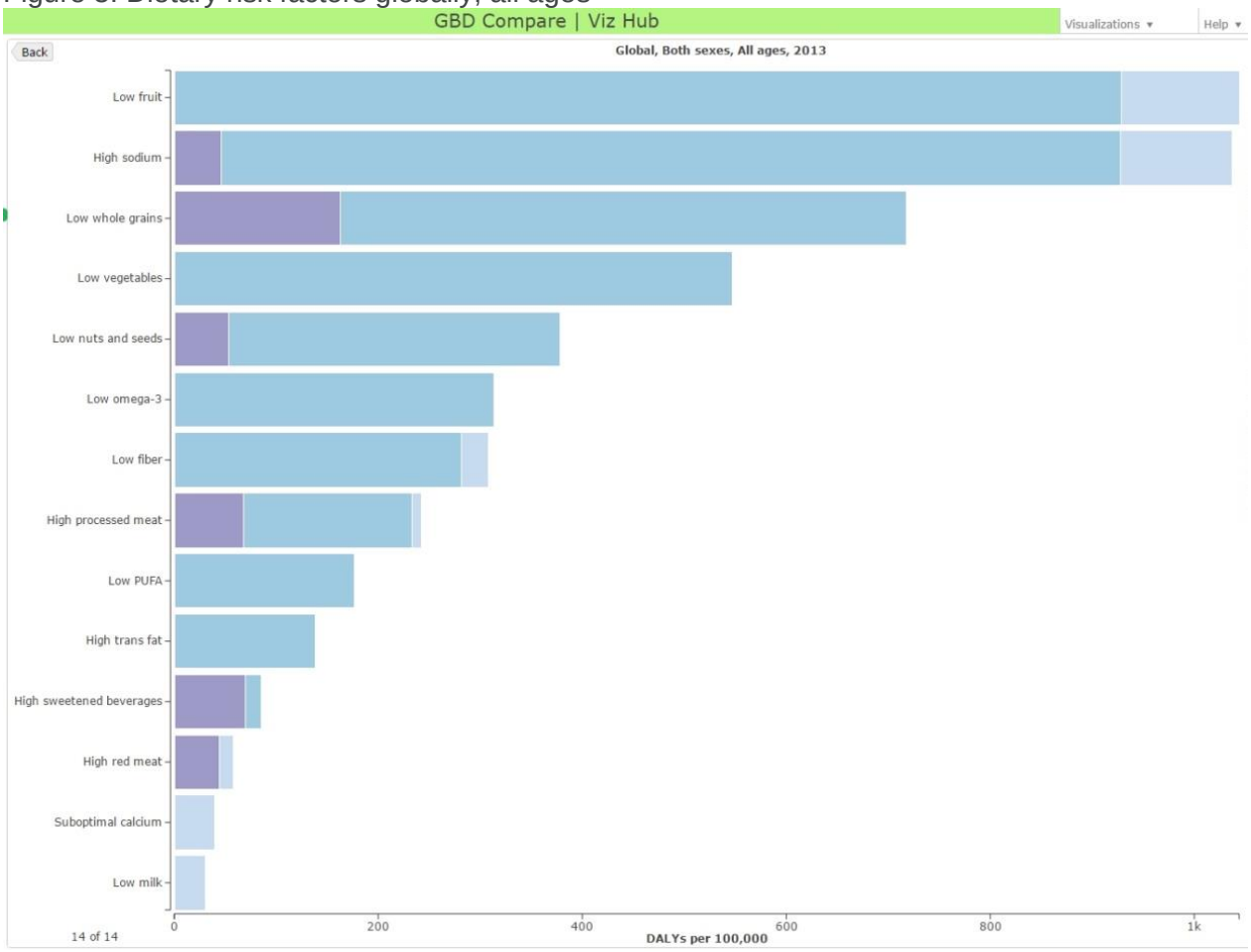
Source: IHME GBD-Compare website, Aug 2016 (2013 data)

Color key:

HIV/AIDS & tuberculosis
Diarrhea/LRI/other
NTDs & malaria
Maternal disorders
Neonatal disorders
Nutritional deficiencies
Other group I
Neoplasms
Cardiovascular diseases
Chronic respiratory
Cirrhosis
Digestive diseases
Neurological disorders
Mental & substance use
Diabetes/urog/blood/endo
Musculoskeletal disorders
Other non-communicable
Transport injuries
Unintentional inj
Self-harm & violence
War & disaster

The GBD study breaks down “Dietary risks” further (Figure 5). The top contributors to dietary risks identified globally are low fruit, high sodium, low whole grains, low vegetables, low nuts and seeds, low omega-3 fatty acids and low fiber — most of these relate to low consumption of minimally-processed, primarily plant-based foods in the diet. These are followed by factors that relate primarily to processed/ultra-processed foods: high processed meat, low polyunsaturated fatty acids, high trans fats, and high sweetened beverages (in addition to the high sodium risk that appears as #2).

Figure 5. Dietary risk factors globally, all ages



Source: IHME GBD-Compare website, Aug 2016 (2013 data)

Color key:

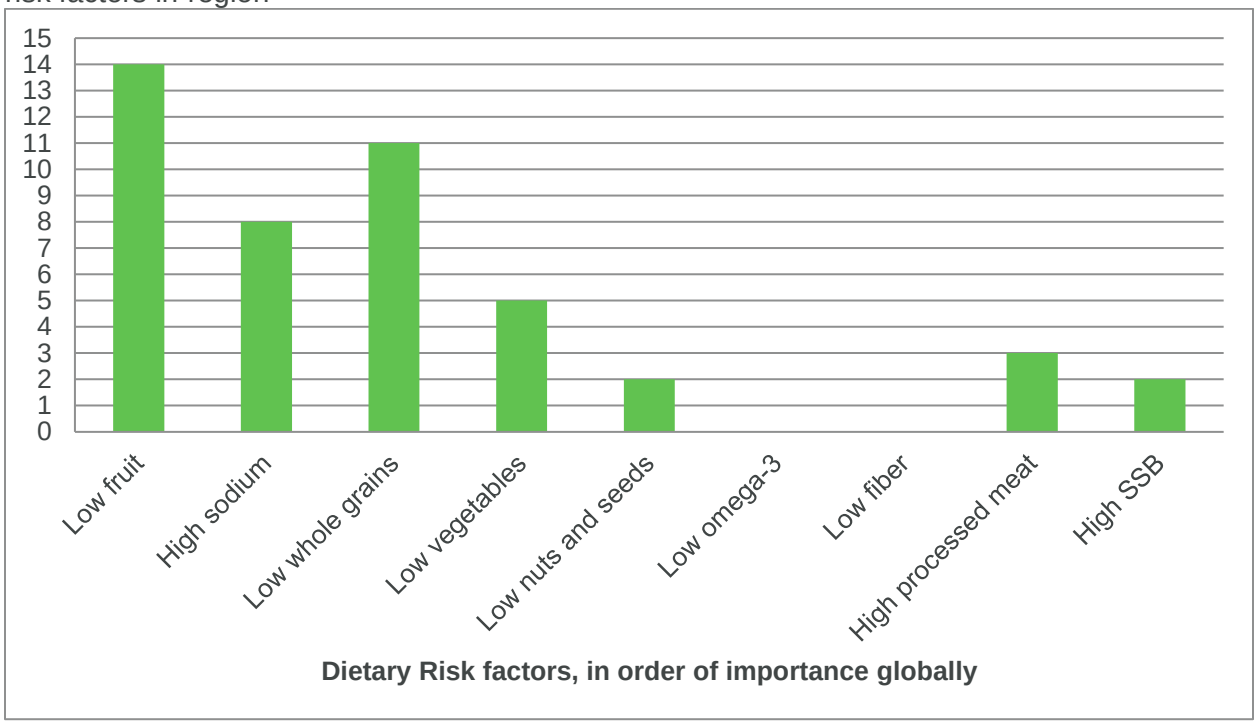
HIV/AIDS & tuberculosis
Diarrhea/LRI/other
NTDs & malaria
Maternal disorders
Neonatal disorders
Nutritional deficiencies
Other group I
Neoplasms
Cardiovascular diseases
Chronic respiratory
Cirrhosis
Digestive diseases
Neurological disorders
Mental & substance use
Diabetes/urog/blood/endo
Musculoskeletal disorders
Other non-communicable
Transport injuries
Unintentional inj
Self-harm & violence
War & disaster

Dietary risks are selected based on how previous research has categorized dietary factors associated with disease outcomes. This explains why fruit and vegetables are not combined, for example, and why fiber is an independent category, although it would overlap with fruits, vegetables, whole grains and nuts and seeds. Inputs into selecting the dietary risk factors analyzed are effect size of the diet-disease relationship, exposure distribution and outcome prevalence (Micha et al., 2012). Annex 1 shows the diet-disease relationships that were the primary basis for GBD estimates.

The global data pool all countries. In thinking about designing a diet module that is valid worldwide, it is helpful to examine how variable these data are between regions and countries. In other words, are the same risk factors most important in all regions, or do the most important risk factors vary by region?

Disaggregated analysis of dietary risk factors by region was carried out using the online GBD-compare tool. Figure 6 shows that the top four risk factors globally are also among the top risk factors in the highest number of regions. All but one region recorded low fruit as a top risk factor, and in 13 of 15 it was the first or second highest risk factor. Central Latin America is the only region out of 15 for which low fruit is not one of the top three risk factors, perhaps because fruit consumption is not low and/or because other risk factors are more important; high SSB and high processed meat are top risk factors there, although they are less commonly top risk factors in the rest of the world. Low whole grains did not feature as a top risk factor in four regions: Sub-Saharan Africa (perhaps because whole grains are not low there), Western Europe, North America and Southern Latin America (perhaps because other dietary risks were more salient, although whole grain consumption is also low there). High processed meat is one of the top three risk factors in three regions (Western Europe, North America and Central Latin America), even though it is the #8 risk factor globally. High SSB strongly feature in diet quality in Central Latin American and the Caribbean, although they are 11th globally. Details of the analysis, including which regions have each top dietary risk factor, are shown in Annex 2.

Figure 6. Number of regions where each global dietary risk factor is one of the top three dietary risk factors in-region



Regions[22] (15) include: Sub-Saharan Africa, Middle East and North Africa, Central Europe Eastern Europe and Central Asia, East Asia, Southeast Asia, South Asia, High-income Asia

[22] Note that the data could be analyzed by WHO or World Bank regions as well. The 15 geographic regions here were chosen because they are more disaggregated and offer more insight into potential differences in dietary patterns by groups of countries. The data could also be further disaggregated by country.

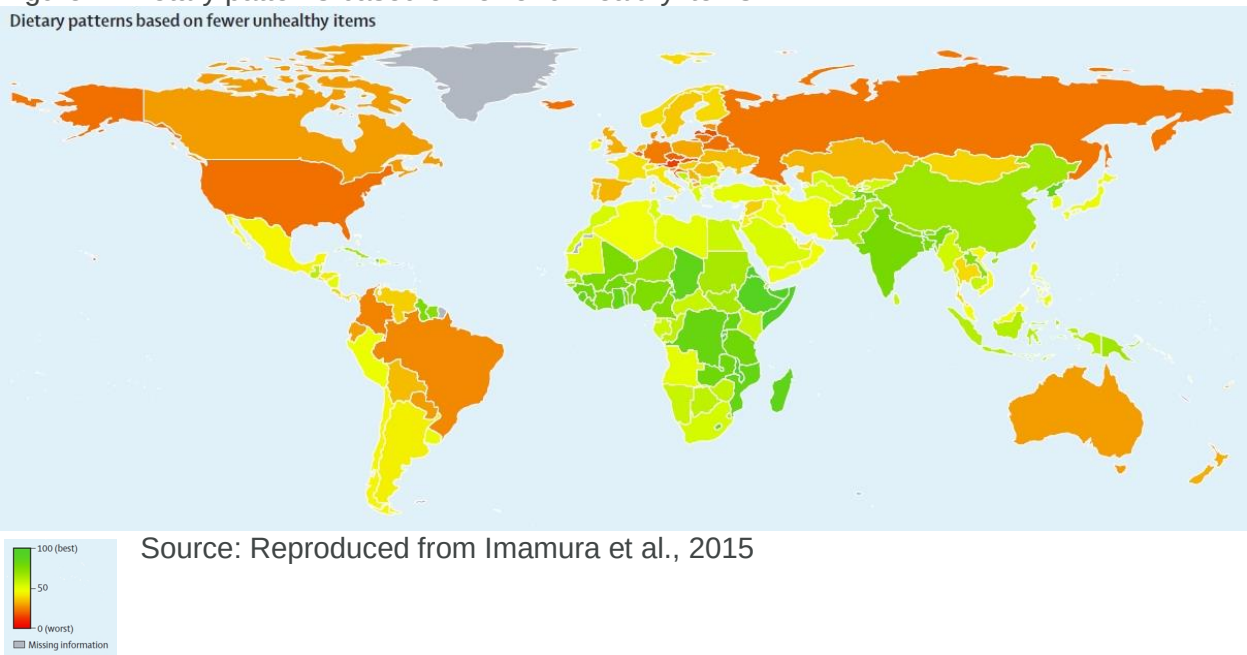
Pacific, Australasia, Oceania, North America, Central Latin America, Caribbean, Andean Latin America, Southern Latin America and Western Europe.
Source: Author
Data source: IHME GBD-Compare

The GBD dietary data have been further analyzed by country. Imamura et al. (2015) analyzed dietary quality among men and women in 187 countries based on consumption of key "dietary items" (foods and nutrients) categorized as healthy (associated with lower disease) or unhealthy (associated with disease). Similar to the rest of the GBD study effort, the 10 healthy items included fruits, vegetables, beans and legumes, nuts and seeds, whole grains, milk, total polyunsaturated fatty acids, fish, plant omega-3s and dietary fiber. The seven unhealthy items included unprocessed red meats, processed meats, sugar-sweetened beverages, saturated fat, trans fat, dietary cholesterol and sodium.

The consumption of healthy foods has been increasing globally, but the consumption of unhealthy foods has been worsening globally at a greater pace. A main conclusion of the study was that diets were quite heterogeneous across countries (Imamura et al., 2015). The implication of this finding is that different elements of the diet may have variable importance to overall diet quality depending on the country — based on its risk of disease and the variation in consumption of the food item. Items with high variation are important to note because indicators that are more variable may be more sensitive to detect differences in diet quality, and/or they may be less applicable across countries. The largest variation in quantity of consumption across and within countries was in whole grains, nuts and seeds, beans and legumes, milk, seafood, sugar sweetened beverages and processed meats (Imamura et al., 2015). Of this list, it is possible that seafood consumption may be related to geography, and differences in milk consumption may be related to lactose tolerance.

In many countries in Africa and South and Southeast Asia, lower consumption of unhealthy items was strongly related to better diet quality. On the other hand, in much of the Americas and Europe, poorer diet quality is related to higher consumption of unhealthy items. (Figure 7)

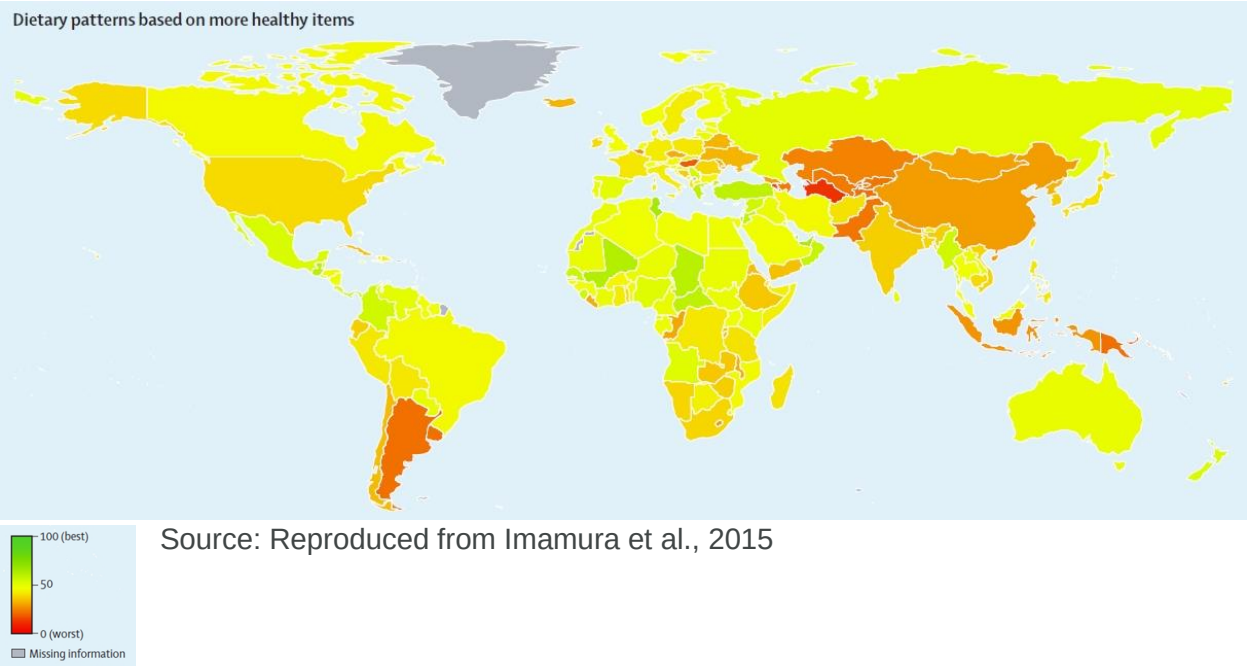
Figure 7: Dietary patterns based on fewer unhealthy items



Source: Reproduced from Imamura et al., 2015

There are fewer countries for which consumption of more healthy items stands out, notably in a few relatively food insecure countries in Africa (Mali, Chad, and Central African Republic), and in some of Latin America where presumably more fruits are consumed. Few healthy items relates to worse diet quality in Central Europe, Eastern Europe and Central Asia as well as parts of Southern Latin America and Oceania. (Figure 8)

Figure 8: Dietary patterns based on more healthy items



Source: Reproduced from Imamura et al., 2015

Does this heterogeneity in dietary patterns mean that diet should be measured differently across regions? Not necessarily. Both low and high consumption of healthy and unhealthy items is important across all countries and regions. Furthermore, diets are shifting, and although the poorest regions of the world currently have the lowest consumption of unhealthy foods, processed food retailers see them as the largest emerging market and are working hard to increase sales and consumption of their (unhealthy) products in those regions.

Using the GDD and other information, Mozaffarian (2016) reviewed evidence for health effects of diet on cardiometabolic diseases, and concluded the following:

> "Evidence-informed dietary priorities include increased fruits, nonstarchy vegetables, nuts, legumes, fish, vegetable oils, yogurt, and minimally processed whole grains; and fewer red meats, processed (e.g., sodium-preserved) meats, and foods rich in refined grains, starch, added sugars, salt, and trans fat. More investigation is needed on the cardiometabolic effects of phenolics, dairy fat, probiotics, fermentation, coffee, tea, cocoa, eggs, specific vegetable and tropical oils, vitamin D, individual fatty acids, and diet-microbiome interactions. Little evidence to date supports the cardiometabolic relevance of other popular priorities: e.g., local, organic, grass-fed, farmed/wild, or non-genetically modified."

This statement is particularly useful, first because of the rigorous evidence base from which it is derived, and second because it identifies areas where there is not yet clear consensus or evidence. The table below further categorizes areas of concordance vs. uncertainty in cardiometabolic effects of diet.

Selected Areas of Concordance and Controversy Related to Diet and Cardiometabolic Health*

	Broad Concordance and Less Controversy or Uncertainty†	General Concordance but Some Remaining Controversy and Uncertainty	Substantial Controversy and Uncertainty	Insufficient Evidence for Meaningful Conclusions
Benefits of:	Fruits, nonstarchy vegetables, nuts/seeds, legumes, yogurt Dietary fiber, potassium Moderate alcohol use Mediterranean-style or higher fat DASH-style diet patterns	Seafood, whole grains Certain vegetable oils (eg, soybean, canola, extra virgin olive) n-3 and n-6 polyunsaturated fats, plant-derived monounsaturated fats Phenolic compounds	Cheese, low-fat milk Certain vegetable oils (eg, corn, sunflower, safflower) Total or animal-derived monounsaturated fats Coffee, tea, cocoa Vitamin D, magnesium, fish oil	Whole-fat milk Starchy vegetables other than potatoes Coconut oil
Harms of:	Partially hydrogenated vegetable oils, processed meats High sodium Sugar-sweetened beverages, foods rich in refined grains, starches, added sugars Greater than moderate alcohol use	Moderate sodium White/russet potatoes High glycemic index/load	Saturated fats, dietary cholesterol Unprocessed red meats, eggs Butter	Whole-fat milk Palm oil
Little effect of:	Total fat	Total carbohydrate Isolated antioxidant vitamins, calcium	Poultry 100% fruit juice Total protein, specific amino acids Noncaloric sweeteners	Concepts of local, organic, farmed/wild, grass fed, genetic modification

DASH indicates Dietary Approaches to Stop Hypertension.
*See article text for details on these topics and on other foods and nutrients.
†Some amount of controversy can be identified for almost any topic in science.

Source: Reproduced from Mozaffarian 2016.

Most salient themes

From the review of healthy diet definitions above, several salient themes stand out. Other aspects of diet do not stand out. Taking into consideration international and national dietary recommendations, epidemiologic meta-analyses in the GBD study and well-vetted dietary patterns, common themes are those that we would look toward measuring across countries.

Firstly, the guidelines are all founded on the same general principle that *a healthy diet protects against all forms of malnutrition and NCDs*. That means that healthy diet recommendations should not target undernutrition at the expense of increased obesity risk, or vice versa. Second, there is already acknowledgement at high level that there is indeed common ground across cultures for what constitutes a healthy diet:

> *"The exact make-up of a diversified, balanced and healthy diet will vary depending on individual needs (e.g. age, gender, lifestyle, degree of physical activity), cultural context, locally available foods and dietary customs.* ***But basic principles of what constitute a healthy diet remain the same."*** *(WHO Healthy Diet Fact Sheet)*

What are these basic principles? The following are distilled from all the definitions and guidance reviewed.

What is very clear

Fruits and vegetables

These are foods universally recommended as positive for health, in 100% of FBDGs, dietary patterns, both in the top-five dietary risk factors in all regions according to the GBD study, and are the only food group for which WHO has defined a daily recommended intake level. They are positive for nutrition and health outcomes regardless of baseline nutritional status or population group. They appear to be a non-substitutable food group; i.e., no other foods can provide the health benefits conferred by fruits and vegetables, which are likely due to phytochemicals and antioxidant activity more so than nutrients.

Ultra-processed foods, including processed meats and sugar-sweetened beverages
WHO and most FBDGs recommend avoiding consumption of what can be called ultra-processed food. The terminology used for these foods is variable. Various terms and classification systems have been used, such as ultra-processed food (Monteiro et al., 2016), foods of minimal nutritional value and processed foods (FAO 2015). They typically include processed meats, sugar-sweetened beverages, fast food and some street foods, snack food, fried food, dried soups such as ramen noodles, sugary snacks and candies. In the GBD study, processed meats and sugar-sweetened beverages are two clear dietary risk factors, and although they are not top risk factors in most regions, the global trend is that consumption of ultra-processed foods is increasing across regions, making it an important area of diet to monitor. Global (WHO) and national guidelines, as well as GBD study, include several nutrients as specifically “unhealthy,” including sodium, added sugars, saturated and trans fats. These track closely with consumption of ultra-processed foods: a higher proportion of dietary energy from ultra-processed foods is associated with poorer diet quality, in terms of nutrients consumed, and with obesity, metabolic syndrome and dyslipidemias (Monteiro et al. 2016, citing Louzada et al. 2015a, Bielemann et al. 2015, Louzada et al. 2015b, Canella et al. 2014, Tavares et al. 2012, Rauber et al. 2015). There is no solid argument that can be made for any positive nutritional contribution of these foods.

What is mostly clear

Whole grains

WHO incudes whole grains in its top-line general recommendation. GBD identifies whole grains as the #2 dietary risk factor globally, and it is identified as one of the top three risk factors in a majority of regions (8 of 15). All FBDGs recommend consumption of grains, and within that recommendation, some specify whole grains. Mozaffarian (2016) identifies whole grains as a dietary item with general concordance but some remaining controversy/uncertainty.

Legumes, nuts and seeds

It is clear that these are unequivocally healthy foods. They are recommended by WHO, part of established healthy dietary patterns, included in 2/3 of FBDGs, and low consumption of nuts (which includes peanuts) is the fifth most important GBD dietary risk factor globally and in “developing” countries. What is not as clear, simply based on lack of emphasis, is whether legumes, nuts and seeds have health effects distinct from other plant foods. It is likely that their positive health effects stem from at least three factors: micronutrients (including high amounts of some minerals), non-nutrient positive components including phytochemicals and fiber, and the reality that they often are functional substitutes for less-healthy animal sources of protein. (Many FBDGs present legumes and nuts as one option in a broader “protein” group.) Their lesser observed impact on health outcomes, compared to fruits and vegetables, may be due to how

they are consumed in smaller amounts or less frequently. Some FBDGs call nuts a "complement" to the diet, rather than something integral. Imamura et al. (2015) observed that quantity of consumption of legumes, nuts and seeds was highly variable within and across countries. No specific amount of consumption of legumes, nuts and seeds is stated in WHO or national DGs, but one analysis (Herforth 2015) calculates that approximately 100g/day of legumes would satisfy protein requirements in combination with starches.

Oils and fats

What is clear is that WHO and many FBDGs clearly recommend avoiding industrially produced trans fats (margarine, hydrogenated oils), caution against saturated fat and endorse the use of unsaturated vegetable oils. Low PUFAs are within the top-10 dietary risk factors globally, but near the bottom of the list. The Mediterranean diet emphasizes olive oil, but that is a culturally-specific oil that is not used globally. Although advice frequently includes guidance to limit intake of saturated fat, this is sometimes a short-hand or euphemism for meat and ultra-processed foods (Nestle 2016). There is not clear communication or consensus on whether different types of saturated fats (tropical oils, butter, lard) have significantly different health impacts.

What is not as clear

Categorization of plant foods

Plant foods are not categorized consistently within dietary guidelines or across studies. Some of the issues include:

- Whether fruits and vegetables are the same category or separate categories.
- Whether nuts and seeds appear as a separate group — they do in GBD, but not in many FBDGs.
- How legumes are grouped: on their own, with nuts and seeds, with meats, with vegetables or even with starches. The GBD study does not yet include legumes as a dietary category related to disease outcomes.
- Which category certain foods belong to (such as peanut, which is often classified as a nut although it is a legume; or green bean, which would be classified as a vegetable although it is a legume; or tomato, which is classified as a vegetable although it is a fruit.)
- Whether there are categories at all — WHO simply advises fruits, vegetables, legumes, nuts and whole grains, written as one single category. Given the lack of strong correlation between culinary uses, common names and botanical classification; and given the overlap between all plant foods and components such as fiber and antioxidants, a single "plant food" category is a refreshing solution to the problem of how to slice and dice categories and nutrition/health benefits.

Dairy

Recommendations about dairy are found across many national FBDGs (most countries communicate dairy as one food group out of four or five), but there is no WHO recommendation on dairy, suggesting a lack of clear-cut evidence and consensus, echoed in the conclusions by Mozaffarian (2016). Although the GBD study identifies "low milk" as a dietary risk factor, it is the least important of 14 risk factors globally, in "developing" countries and in almost all regions. It is possible that FBDGs include dairy because they are meant to inform all age groups including children, for whom dairy may be more appropriate and important, while WHO guidance and GBD study focus exclusively on adults. Imamura et al. (2015) show that dairy is one of the dietary items for which consumption is most variable. That variability could reflect differences in

lactose tolerance across populations, which plays a strong role in cultural norms of milk use beyond childhood.

Fish

Fish is positive for health outcomes in the GBD study, is part of the Mediterranean diet pattern and is often included in FBDGs. It is not included in WHO recommendations. It is unclear whether fish is necessary or substitutable in diets. The omega-3 fatty acids it contains, which are correlated with better heart health, can be obtained from plant sources (albeit not as easily). It is one of the dietary items that is most variable across the globe (Imamura et al., 2015), probably due to differences in geography. Low intake of omega-3 fatty acids does not appear as one of the top three dietary risk factors in any region, although it is the number six dietary risk factor globally (GBD Risk Factors Collaborators 2015). Most importantly, however: it is not ecologically possible for the entire human population to increase consumption of fish. Doing so would necessitate a transition from wild to farmed fish, with very unclear implications for health, since the fatty acid profile of farmed fish can differ vastly from wild fish. For these reasons, fish consumption is not a top priority to measure globally.

Meat

Red meat is associated with negative health outcomes in the GBD study, but most FBDGs include some sort of recommendation about consuming meat or another protein. An argument could be made that increasing meat consumption among undernourished populations is positive for nutrition, due to increasing consumption of bioavailable micronutrients that those populations may be lacking or may have difficulty getting from other relatively inaccessible sources. There is no recommended amount of meat consumption, however, and it is a fully substitutable food, meaning that meat has no essential nutrients or other components that cannot be obtained from other foods. In high-income countries, vegetarian diets are associated with better nutritional status and health outcomes (ADA 2009). WHO has no recommendation on meat consumption, other than to avoid consuming fatty and processed meats. Meat production, especially red meat, typically has negative environmental consequences, issues around humane treatment of animals, along with inequitable/unevenly distributed externalities on people, so increasing consumption cannot be considered positive for both people and the planet (Pray et al. 2014, Marlow et al. 2009, Hedenus et al. 2014, Kastner et al. 2012). Therefore it would be difficult to define either an ideal absolute level of meat consumption or even a level relative to other foods in the diet. Increases or decreases in meat consumption would not have a clear and universal positive or negative interpretation.

Summary of dietary guidance around the world

Based on the above-identified themes, if someone were to plan a diet around existing definitions and guidance, here is what could be said most emphatically:

- Eat an abundant variety of fruit and vegetables.
- Do not eat ultra-processed foods, including SSBs, processed meats and salty and sugary snacks.
- Do not eat industrially-produced trans fats (in margarine or processed foods).

Advice that comes up in most guidance and evidence includes:

- Eat whole grains.
- For fats and oils, use unsaturated vegetable oils.

Thinking about the whole diet, the nutrient mainly missing from the above advice is a protein source to complement whole grains. In general:

- Legumes and nuts are highly recommended; fish is highly recommended nutritionally but not environmentally feasible for all; milk/yogurt is generally positive depending on lactose tolerance and food culture; little to say about eggs and unprocessed poultry; unprocessed red meat is generally negative; and processed meats are not advisable.

This summary, resulting from the analysis presented in this paper, is similar to many other authors' conclusions,[23] such as Michael Pollan's pithy statement of dietary advice: "Eat food. Not too much. Mostly plants."

These most salient elements of diet quality are echoed by WHO:[24]

> *The increased production of processed food, rapid urbanization and changing lifestyles have led to a shift in dietary patterns.* ***People are now consuming more foods high in energy, fats, free sugars or salt/sodium, and many do not eat enough fruit, vegetables and dietary fibre such as whole grains.*** (WHO Healthy Diets Fact Sheet).

Note here, the text points out that a shift in dietary patterns is occurring in many places around the world (also referred to as the "nutrition transition"), with the implication that limiting dietary information to important aspects of diet quality in *current* diets could potentially miss *emerging* elements of diet quality that are rapidly changing. This provides support for a proposal to measure these elements of diet quality across cultures.

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[23] The Global Nutrition Report 2016 compiles recommendations for food system changes needed to achieve dietary goals (GNR Table 6.3, p 67). The dietary goals included are strikingly similar to those listed here:

- Increase fruit and vegetable intake
- Increase intake of legumes/pulses
- Increase intake of grains high in protein, micronutrients and fiber
- Encourage balanced consumption of safe milk *(note: unclear what "balanced" means here)*
- Replace saturated and trans fats with unsaturated fats
- Reduce intake of high-calorie, nutrient-poor sugary drinks and salty snacks

[24] It is interesting that, like the U.S. dietary guidelines and like the categorizations used in a substantial body of nutrition epidemiology research, the "moderation" components are defined in terms of nutrients, and the "adequacy" components are defined in terms of foods. This is similar to the GBD study, where most of the "healthy" dietary components that could be identified from existing literature are foods, and most of the "unhealthy" dietary components are nutrients (except processed meats, unprocessed red meats and sugar-sweetened beverages).

What Should Gallup Measure?

In an endeavor to capture indicators of dietary quality across countries, we want indicators with an unequivocal direction: that when they increase, that is either positive or negative. We do not want indicators for which the implication of an increase is unclear — i.e., an increase could be positive or negative, depending on other factors such as the respondent's life stage, nutritional status, genetics or other elements of the diet. Furthermore, we would ultimately like indicators for which an absolute number reflects something, regardless of whether the number is going up or down over time.

Therefore, the following dietary components are those which a global diet quality module should seek to measure.[25]

Dietary elements we would like to measure

- Consumption of fruits and vegetables
  - Possible desired indicator outcome/interpretation: % of the population habitually consuming **adequate** fruits and vegetables ("Adequate" could be defined as five servings/day or approx. 400g, as per WHO recommendations).

- Consumption of plant foods in general, including fruits, vegetables, whole grains, legumes and nuts (as stated in the top line of the WHO points defining a healthy diet).
  - Possible desired indicator outcome/interpretation: % of the population habitually consuming **minimum diversity** of plant foods (Cut-off to be determined)

- Consumption of ultra-processed foods
  - Possible desired indicator outcome/interpretation: % of the population habitually consuming more than [some small amount to be determined] of ultra-processed foods

Dietary elements for which there is not a strong argument for measurement

- In a word: animal-source foods. We should not seek to measure consumption of fish, milk, meat or eggs because (1) their health and/or environmental effects are equivocal, and (2) there is no absolute nutritional requirement for any of these categories for adults, i.e., they are substitutable for positive health impacts.

- Unsaturated vegetable oils are a dietary item for which there is general consensus (that they are the preferred form of fat, compared to other fats), but it is unclear if they are important enough to diet quality to monitor. Because increases/decreases in consumption or absolute amounts consumed would have little meaning (i.e., it would not clearly be positive or negative), any indicator would need to be about habits rather than amount.

[25] In a review of diet quality indices, Vandevijvere et al. (2013) concluded that "Different foods and nutrients have been used in [diet quality] indices, although some specific ones (fat, fruits, vegetables and whole grains) are used in the majority of indices because of their established health impact."

Dietary elements we might like to measure but won't be able to

Because this endeavor is about qualitative indicators of diet quality rather than quantitative dietary intake measurement, we will not be able to measure:

- Caloric intake
- Nutrient intake
- Overall balance of macronutrients (for which there is no clear consensus in any case)
- Exact amounts of foods consumed (e.g., mean intake at individual level of fruits and vegetables)
- Fat intake
- Free sugar intake
- Salt intake (the only valid way to estimate salt intake is spot urine analysis, which is now being integrated into the STEPS survey)

However, for the last three items on the above list — fat, free sugars and salt — consumption of ultra-processed foods may be a very good proxy (see box below).

How can the key elements of diet be measured?

Diverse plant foods and ultra-processed foods are key elements of diets that we would like to be able to measure. These are multi-faceted food constructs, however, so a first question is how to break them down conceptually into something manageable in asking and analyzing survey questions. A second question is what method to employ within a survey to measure each construct. A third question is how precisely to ask the questions so that they are valid indicators of plant food and ultra-processed food consumption.

Sub-categories of diverse plant foods and ultra-processed foods

This section discusses how to define diverse plant foods and ultra-processed foods. It aligns with this observation: "In the event that a single diet quality indicator is recommended for monitoring diet quality globally, it will be important to define the food groups in detail, so that countries use the same definitions to classify foods into those food groups, while allowing flexibility for the classification of culturally specific foods." (Vandevijvere et al., 2013)

Ultra-processed foods as a proxy for salt, sugar, and fat

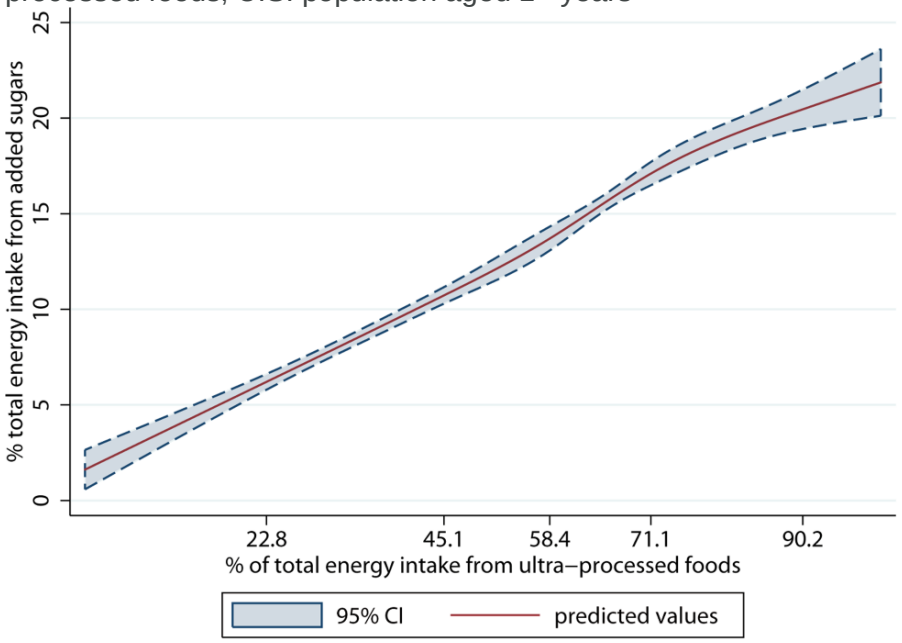
Salt

WHO Healthy Diets Fact Sheet states: “People are often unaware of the amount of salt they consume. In many countries, most salt comes from processed foods (e.g., ready meals; processed meats like bacon, ham and salami; cheese and salty snacks).” It also gives the practical advice, “You can reduce salt consumption by limiting the consumption of salty snacks” and “Potassium, which can mitigate the negative effects of elevated sodium consumption on blood pressure, can be increased with consumption of fresh fruits and vegetables.” Taken together, this guidance indicates that (a) increases in fruits and vegetables and (b) decreases in ultra-processed foods can both reduce sodium consumption and its health impacts.

Sugar

Research has found that a higher intake of ultra-processed foods is directly and strongly correlated with added sugar intake in the U.S. (Figure 9). If true in a broader array of countries, this finding indicates that UPF consumption could be a valid proxy for sugar intake.

Figure 9. The dietary content in added sugars regressed on the dietary contribution of ultra-processed foods, U.S. population aged 1+ years



Source: Reproduced from Martínez Steele et al. 2015

Trans fats

As may also be the case for added salts and sugars, people do not seek out trans-fats to eat or even know they are eating them; it’s a food ingredient they are exposed to rather than an active dietary choice, and can therefore be closely reflected in intake of ultra-processed foods. Consumption of ultra-processed foods was found to be correlated with cholesterol levels in Brazilian children (Rauber et al., 2015).

Diverse Plant Foods

For plant foods, the evidence and existing guidance suggests that we care about two elements: amount and diversity.

- **Amount** consumed cannot be captured precisely by a qualitative survey, but frequency is a generally valid proxy for amount, which *can* be captured.
- There are various ways **diversity** could be captured; some ideas are presented in the table below.

Possible ways to categorize plant food diversity

	Pro	Con
FBDG-based food group categories (including fruits, vegetables, legumes, nuts, grains)	• Familiar, and consistent with WHO recommendations	• Hard to agree on; inconsistent across countries (3, 4 or 5 or more categories?) • Somewhat arbitrary weighting
MDD-W categories (7 of the 10 MDD-W categories are nutrient-dense plant foods)[26]	• Validated as positive for nutrient adequacy • Not far from FBDG food group categories • Includes color to some extent (indicator of functional nutrient and/or phytonutrient content) • List-based methodology has been tested	• Somewhat arbitrary weighting (why 7 categories? Why not 5 or 10 or 15?) • Dividing fruits and vegetables into "vitamin A-rich" and "other" is not very relevant to current priorities in global nutrition. (The unintentional benefit of that division is that it captures colors.)
Colors (Red, Orange/yellow, Green, Blue/purple)	• Recommended by some national FBDGs, and frequently included in nutrition education strategies • Indicates functional nutrient and/or phytochemical content	• Not emphasized across FBDGs or internationally • Limited interpretability for policy (cut-off point?)
Botanical families (e.g. Rosaceae, Liliacieae, Cucurbitaceae, etc.)	• No question about how to categorize foods • Probably the best way to indicate functional phytochemical content (Thompson et al., 2006)	• Limited interpretability for policy and communication/ awareness-building strategies (cut-off point?)

Based on the above pros and cons, there is not a clear best option for capturing plant food diversity. How to categorize plant foods for question design and analysis needs discussion and research.

Ultra-processed foods

Various ways to categorize foods by level of processing have been defined, reviewed by Moubarac et al. (2014) and several presented in FAO 2015. The discussion here is limited to ultra-processed foods, as defined in the NOVA classification (Monteiro et al., 2016). Within ultra-processed foods (UPFs), we will need to define the sub-categories to be included in the questionnaire, given that respondents will not be able to say how much "ultra-processed food" they eat as a general category.

[26] [Whole] grain foods, Pulses, Nuts and seeds, Dark green leafy vegetables, vitamin A-rich vegetables and fruits, Other vegetables, Other fruits

"Ultra-processed foods" are defined as "formulations of several ingredients which, besides salt, sugar, oils and fats, include food substances not used in culinary preparations, in particular, flavours, colours, sweeteners, emulsifiers and other additives used to imitate sensorial qualities of unprocessed or minimally processed foods and their culinary preparations or to disguise undesirable qualities of the final product." (Moubarac et al., 2014) They typically are "energy dense; have a high glycaemic load; are low in dietary fibre, micronutrients and phytochemicals; and are high in unhealthy types of dietary fat, free sugars and salt." (Vandevijvere et al., 2013)

Sub-categories of UPFs have been variously described by the researchers who developed the definition:

Monteiro et al. 2016	Martínez Steele et al. 2015	Moubarac et al. 2014
"Examples of typical ultra-processed products are: carbonated drinks; sweet or savoury packaged snacks; ice-cream, chocolate, candies (confectionery); mass-produced packaged breads and buns; margarines and spreads; cookies (biscuits), pastries, cakes, and cake mixes; breakfast 'cereals', 'cereal' and 'energy' bars; 'energy' drinks; milk drinks, 'fruit' yoghurts and 'fruit' drinks; cocoa drinks; meat and chicken extracts and 'instant' sauces; infant formulas, follow-on milks, other baby products; 'health' and 'slimming' products such as powdered or 'fortified' meal and dish substitutes; and many ready to heat products including pre-prepared pies and pasta and pizza dishes; poultry and fish 'nuggets' and 'sticks', sausages, burgers, hot dogs, and other reconstituted meat products, and powdered and packaged 'instant' soups, noodles and desserts."	Breads Cakes, cookies and pies Salty snacks Frozen and shelf-stable plate meals Soft drinks, carbonated Pizza (ready-to-eat/heat) Fruit drinks Breakfast cereals Sauces, dressings and gravies Reconstituted meat or fish products Sweet snacks Ice cream and ice pops Milk-based drinks Desserts French fries and other potato products Sandwiches and hamburgers on bun Instant and canned soups Other ultra-processed foods	Chips (crisps), many types of sweet, fatty or salty snack products; ice cream, chocolates, candies (confectionery); French fries (chips), burgers and hot dogs; poultry and fish 'nuggets' or 'sticks' ('fingers'); breads, buns, cookies biscuits); breakfast cereals; pastries, cakes, cake mixes; 'energy' bars; preserves (jams), margarines; desserts; canned, bottled, dehydrated, packaged soups, noodles; sauces; meat, yeast extracts; soft, carbonated, cola, 'energy' drinks; sugared, sweetened milk drinks, condensed milk, sweetened including 'fruit' yoghurts; fruit and fruit 'nectar' drinks; instant coffee, cocoa drinks; no-alcohol wine, beer; pre-prepared meat, fish, vegetable, cheese, pizza, pasta dishes; infant formulas, follow-on milks, other baby products; 'health', 'slimming' products such as powdered or 'fortified' meal and dish substitutes."

These categories are quite extensive and may not all be valid to include as indicators of unhealthy UPFs across all settings. (For example in some settings, "desserts" may imply a bowl of fruit or rice with mango.) Other definitions of diet quality, discussed above, have included UPFs without labeling them as such: Types of UPFs that the GBD study has identified as being important dietary risk factors are processed meats and sugar-sweetened beverages. WHO advises limiting "ready meals; processed meats like bacon, ham and salami; cheese and salty snacks." Some FBDGs specifically urge moderation on packaged salty or sugary snacks, dried soups such as ramen noodles, cakes and cookies and others. At a minimum, processed meats and sugar-sweetened beverages are important UPF sub-groups. Other sub-groups can be discussed for their importance and cross-cultural relevance.

Methods for measuring the key aspects of diet

Three basic methodologies may be used to ask respondents about dietary intake: Open recall, screeners or preference questions. Only those methods relevant to a survey are included (direct observation and food diaries are not included).

Some examples of tools follow, that have been used to measure the key dietary elements identified above (plant foods and ultra-processed foods). This is an indicative sample rather than an exhaustive review.[27]

Open recall

An open recall consists of asking a respondent to list everything she or he ate and drank in the last day, guided by the enumerator. This method yields a great amount of information about actual intake, is relatively easy for respondents to answer and confers a high amount of flexibility in how the data are analyzed, including the potential for re-analysis of data according to new or different priorities for understanding various pieces of diets. The MDD-W measurement guide (FAO and FHI360 2016) recommends an open recall method, although it provides information on carrying out the list-based method as well. That said, an open recall is unlikely to be viable within GWP. Detailed probing and careful coding are critical, which requires extended interviewer training and local food expertise on behalf of the interviewers. Open-recall methods are more commonly used in environments with low dietary diversity, and could be more cumbersome where a large number of food items including mixed dishes may have been consumed. Furthermore, analysis needs to be simple (ideally not requiring nutrition expertise in categorizing responses) for timely information to be provided and used. While open recall is an option to consider, list-based methods/screeners are more likely to be feasible and valid within Gallup World Poll.

Screeners

A screener is a short questionnaire that asks about specific key aspects of the diet (NCI 2016). Two types of approaches are primarily used for screeners:

- A short food frequency questionnaire, usually without portion size questions.
- A behavioral questionnaire that asks about general dietary practices

SCREENER TYPE 1: FOOD FREQUENCY QUESTIONNAIRES (FFQ)[28]

A short FFQ can be designed to capture eating behavior over a specified recall period. The following examples are FFQ-type screeners with a variety of recall periods, including “yesterday,” “in the past week,” “in a typical week,” “in the past 30 days” and “how often” (with choices specified). There are some methods that ask for number of servings or amount, but most of these depend on picture cards, which will not be feasible in GWP given that in many countries, interviews are conducted over the phone. Some quantitative information can be gleaned from this type of question; number of times of consumption over a specified period is a proxy for amount consumed.

[27] Further examples of published dietary survey instruments for children and adults can be found here: (1) **http://appliedresearch.cancer.gov/diet/screeners/** (2) **http://tools.nccor.org/measures**

[28] In contrast to a short FFQ for a screener, a FFQ to assess complete diet is usually 80-120 items in length; several validated FFQs have been used to assess total diet quality.

The following are examples of questions that have been used to capture plant food or UPF intake.

MDD-W (FAO and FHI 360, 2016)

- Yesterday during the day or at night, did you eat or drink…
  - Any vegetables or roots that are orange-colored inside, like [local examples]. (Yes/No)
  - Any dark green leafy vegetables, such as
  - Any fruits that are dark yellow or orange inside, like
  - Any other fruits
  - Any other vegetables
  - Any beans or peas, such as
  - Any nuts or seeds, like
  - Any savory and fried snacks, such as
  - Any sugar-sweetened beverages, like

PREDIMED 14-point Mediterranean Diet Adherence Screener includes (Schröder et al. 2014)

- How many servings of vegetables do you consume per day? (count garnish and side servings as ½ point; a full serving is 200g)
- How many carbonated and/or sugar-sweetened beverages do you consume per day?
- How many 150-g servings of legumes do you consume per week?
- How many times do you consume commercial (not homemade) pastry, such as cookies or cake, per week?
- How many times do you consume nuts per week? (1 serving = 30g)
- How many times per week do you consume boiled vegetables, pasta, rice, or other dishes with a sauce of tomato, garlic, onion, or leeks sautéed in olive oil?

Short Diet Questionnaire Used in GISSI-Prevenzione Trial

This screener was used in several studies on the association between the Mediterranean diet and disease outcomes. “of the five foods considered, fish, fruit, raw and cooked vegetables and olive oil, there was no evidence that any one of the foods had a completely dominant effect over the others; each of the foods seems to have an important protective effect even when the effects of the other four foods had been accounted for. The five foods chosen here [cooked vegetables, raw vegetables, fruit, fish, olive oil] as macro indicators of healthy dietary habits after myocardial infarction have previously been shown to be associated with decreased risk, particularly for coronary heart disease.” (Barzi et al., 2003) “all foods were associated with a significant reduction in risk of death. Compared with people in the worst dietary score quarter, the odds ratio for those in the best score quarter was 0.51 (95% ci 0.44 — 0.59).” (Barzi et al., 2003)

- Consumption of cooked vegetables
- Consumption of raw vegetables
- Consumption of fruit
  - (Never or occasionally, 2-3 times/week, once/day, more than once/day)

WHO STEPS survey[29]

This tool does not collect quantitative intakes of fruits and vegetables, but rather self-reported habitual servings consumed. The methodology uses showcards and therefore depends on face to face interviews.

"The next questions ask about the fruits and vegetables that you usually eat. I have a nutrition card here that shows you some examples of local fruits and vegetables. Each picture represents the size of a serving. As you answer these questions please think of a typical week in the last year."

- In a typical week, on how many days to you eat fruit?
- How many servings of fruit do you eat on one of those days?
- In a typical week, on how many days to you eat vegetables?
- How many servings of vegetables do you eat on one of those days?
- How often do you eat processed food high in salt? By processed food high in salt, I mean foods that have been altered from their natural state, such as packaged salty snacks, canned salty food including pickles and preserves, salty food prepared at a fast food restaurant, cheese, bacon and processed meat [add country specific examples].

Global School-Based Health Survey (GSHS)[30]

- During the past 30 days, how many times per day did you usually eat fruit, such as [country specific examples]?
- During the past 30 days, how many times per day did you usually eat vegetables, such as [country specific examples]?
- During the past 30 days, how many times per day did you usually drink carbonated soft drinks, such as [country specific examples]?
  - (never, <1 time/day, 2 time/day, 3 time/day, 4 time/day, 5 or more times/day)
- During the last 7 days, how many days did you eat food from a fast food restaurant such as [country specific examples]
  - (0-7 days)

Food, Health and Choices questionnaire (FHC-Q) (Gray et al., 2016)

- In the past week, I ate…[specific common fruit or vegetable such as apple, banana, broccoli, etc.]
- In the past week, I drank…[sodas, sports drinks, fruit drinks and sweetened iced tea]
- In the past week, I ate…[potato chips, tortilla chips, corn chips and puffs]
- In the past week, I ate…[other salty snacks]
- In the past week, I ate…[candy; donuts and pastries; cookies, brownies, pies or cakes]
  - 0 times, about 1-2 times, about 3-4 times, almost every day, 2 or more times every day
- How much did you usually eat at 1 time of [food item above]
  - I didn't eat this, less than small, small, medium, large, more than large (show pictures)

[29] Available at **http://www.who.int/chp/steps/en/**
[30] Available at **http://www.who.int/chp/gshs/en/**

The Canadian Chronic Disease and Injury Indicator Framework collects two indicators on healthy eating and unhealthy eating (Government of Canada 2016)

- *Healthy Eating:* % of population that reports consuming fruit and vegetables at least five times/day, population aged 12+ years
  - The measure description notes, "Validation studies indicate that this indicator can be used reliably as a proxy for quantified intake of fruit and vegetables (i.e., number of servings per day) and an approximation of diet quality. A high rate for this indicator can be interpreted as a positive result."
- *Unhealthy Eating:* % of population that reports drinking sugar-sweetened beverages daily, population aged five to 19 years
  - The measure description notes, "Children were classified as drinking sugar-sweetened beverages (i.e. regular soft drinks, sport drinks, or fruit drinks) every day if their average daily consumption was equal or greater than one sugar-sweetened beverage per day. The Canada's Food Guide recommend to limit beverages high in calories such as fruit flavoured drinks, soft drinks, sports and energy drinks and sweetened hot or cold drinks. A low rate for this indicator can be interpreted as a positive result."

SCREENER TYPE 2: SELF-REPORTED HABITS

Asking people to report their dietary habits is another technique which may reflect dietary consumption. Self-reported habits could be considered a subjective type of behavior recall. No quantitative intake information can be interpreted from the results of a habit-type question or module.

Gallup GPSS survey module on food habits

Gallup has experience asking about dietary habits in its annual Gallup Poll Social Series survey, which includes some dietary items of interest, such as soda or pop, vegetables and fruits (see the following). The simplicity of this kind of question is both an advantage and a disadvantage; it is easy to analyze and interpret, but may be difficult to answer in a binary way, as the true answer may be somewhere in between. It also may be only crudely related to diet quality: almost everyone in this survey reports trying to include fruits and vegetables in their diet, but far fewer than 90 to 93% of Americans have adequate consumption of fruits and vegetables. This sort of question is particularly susceptible to a "health halo" effect: where respondents are likely to respond positively to questions they know are about foods they should eat more of.

Most Americans Say They Avoid Soda in Their Diets

Thinking about the food you eat, for each of the following please say if it is something you actively try to include in your diet, something you actively try to avoid or something you don't think about either way.

	% Include	% Avoid	% Don't think about
Diet soda or pop ^	22	62	14
Regular soda or pop ^	22	61	16
Sugar	28	50	22
Fat	25	47	27
Salt	35	39	25
Carbohydrates	44	25	29
Beef and other red meat	63	20	17
Gluten-free foods	21	17	58
Grains such as bread, cereal, pasta and rice	70	14	15
Dairy products	68	13	17
Organic foods	44	11	44
Fish and other seafood	76	10	13
Chicken and other poultry	83	4	12
Vegetables	93	2	5
Fruits	90	1	8

Sorted by % Avoid
^ Indicates asked of half sample
July 8-12, 2015

GALLUP

Another way "avoid/include" questions have been phrased is as "yes/no" questions such as in the following example:

STEPS expanded survey

Do you do any of the following on a regular basis [to control your salt intake]? (Yes/No)

- Limit consumption of processed foods
- Avoid eating foods prepared outside the home

Daily routine questions are another way to assess respondents' habits, which could be less susceptible to the "health halo" effect based on the task to recall typical daily routines rather than intention ("try to include"). Research would need to be done on how variable the responses are to such questions, and how closely they relate to actual behavior.

Food, Health and Choices questionnaire (FHC-Q) (Gray et al., 2016)

- Eating fruits and vegetables is part of my daily routine.
- When I think about myself, eating fast food is part of my daily routine.
- When I think about myself, eating packaged snacks is part of my daily routine.
- When I think about myself, drinking sweetened beverages is part of my daily routine.
  - Not true at all for me, Not true for me, Neither true or not true, Somewhat true for me, Very true for me

The Adolescent Food Habits Checklist (Johnson et al., 2002)

This is a set of 23 questions that has been validated as a measure of healthy eating behavior in adolescents in a high-income setting. It combines several types of questions, including "avoid" type questions, "routine" type questions, self-report of overall diet quality and preference questions. This module is quite culturally specific and could not be adapted for cross-culturally valid use, but provides an example of how multiple types of questions could be combined into a single score. The single score on "healthy eating behavior," however, is unlikely to be interpretable for informing specific policies.

Finally, it is possible to ask people to rate the quality of their own diet. Vignettes which illustrate a diet pattern of a fictional individual could be used for comparison, to evaluate bias in questions related to perceptions of diet quality. However, previous research on perceived diet quality (PDQ) found that such questions did not correspond very well to measured diet quality (Powell-Wiley et al., 2014).[31]

Preferences

Food Preferences are a measure of how much intervention participants like specific fruits and vegetables, a factor which is strongly linked to fruit and vegetable consumption in the U.S. school setting (Domel, 1993, Baxter, 2002). A maxim is that people like what they eat, rather than eat what they like (Roach 2013), and if that is true, then preference questions may reflect actual consumption well. While worth exploring, it is probably unlikely that these type of questions work as well for adults, particularly low-income adults, who may like many more kinds of foods than they are actually able to access or afford. If this kind of indicator is more valid in high-income than low-income settings, it would not be a good candidate for a global survey.

An example of a preference question comes from the **SNAP-ED program survey** for adults and children (Washington State Department of Health 2009), where respondents are asked:

- How much do you like these fruits and vegetables? [list each item one by one]
  - I like this a lot, I like this a little, I do not like this, I don't know what this is

[31] "To assess PDQ in the overall US population and population subgroups, we used the Diet Behavior and Nutrition questionnaire (DBQ) of the 2005–2006 NHANES. The DBQ contains questions and data relevant to nutrition and dietary behaviours. NHANES participants answered the question 'In general, how healthy is your overall diet?' on a 5-point Likert scale, with possible answers ranging from 'excellent' to 'poor'. Participants' responses to this question were used to generate PDQ scores."

Which methods should Gallup use?

The answer to what elements of diet should be measured is clearer than how to measure them. There is no clear best way, and unlike the Voices of the Hungry development, there is no ready set of questions that can be adapted and scaled up. The sample questions above are not necessarily validated; some have been found to be correlated with an outcome of interest (for example PREDIMED and GISSI-Prevenzione screener were associated with lower risk of heart attack, and MDD-W is a valid indicator of nutrient adequacy), but not necessarily with all outcomes of interest or our outcomes of interest. For the questions that have been validated in some way, most measures focused on conceptual validity rather than reliability of the method itself (i.e., whether people understand it and answer in the same way). Validation on the reliability of questions is less easily found (Gray et al., 2016; Johnson et al., 2002).

The following table lays out the pros and cons of each methodology and considerations for discussion. The next two tables contain discussion around some of the examples of questions shown above.

Comparison of possible methods

Method	Pro	Con	Issues to grapple with	Conclusions
Open recall	Can reflect total diet Can yield some quantitative information (servings consumed) Methodology is inherently cross-culturally valid Relies on specific rather than generic memory which tends to be cognitively easier for respondents	Short term time frame (1 day) is more indicative of usual diet pattern in low-resource settings, with the implication that random error would probably be higher in high-income than low-income countries Effective probing requires enumerator training and knowledge of local foods and eating norms; enumerators may differ in their ability to do this well Analysis more difficult and not necessarily feasible within GWP	How to analyze the results	Can be discussed because it yields a different and more complete type of information than other options. However it would be difficult to scale up the use of this methodology within GWP.
FFQ screener	Can reflect general diet pattern / longer term than 1 day Can yield some quantitative information (e.g. servings typically consumed) Designed to capture actual consumption behavior (as opposed to overall perception) Easy to interpret what the results mean	Cross-cultural comparisons are more difficult/require careful local adaptation Potential for systematic error (can be calibrated based on validation studies) Cognitively the most difficult to answer (some types of questions are easier than others)	Reference period (1 day, 1 week, 1 month, or a combination) How many questions to include Whether to lump multiple food items into each question, vs. to aggregate results of multiple questions on single food items into an overall food group result.	The major attributes of this type of approach are the ability to yield some quantitative information and the ease of interpretation given that the questions are designed to measure actual consumption. The largest down-side is the cognitive difficulty for the respondent and the challenge for us of deciding whether/how to lump multiple food items into each question vs. aggregate results of multiple questions.

Habits screener	Can reflect general diet pattern Generally easier to answer than FFQ questions	Cross-cultural comparisons are more difficult/require careful local adaptation Potential for systematic error Does not yield quantitative information	How to aggregate questions about specific foods into results about food groups	The major attribute of this type of question is that the best habit questions are probably easier for the respondent to answer than the best FFQ type questions. This type of question may work well for UPFs; but it may not be able to capture diversity in plant foods.
Preferences	Easy to answer	Does not reflect consumption behavior (although in U.S. children it is highly correlated with consumption, and easier to answer than actual consumption questions, thus probably a good measure in that population) Correlation of preferences with consumption is likely dependent on age, income and food environment; therefore it is unlikely this question could yield cross-culturally valid reflections of consumption	Which foods to include that are indicative of the key dietary elements and how to aggregate responses	Not a good candidate for GWP

Sample questions — FFQ screener

	Question examples	Remarks
Worse questions	How many 150-g servings of legumes do you consume per week?	Difficult for people to estimate "servings" or amounts they ate in terms of grams/weight. Better to ask about "number of times" something was consumed.
	How many times per week do you consume boiled vegetables, pasta, rice or other dishes with a sauce of tomato, garlic, onion or leeks sautéed in olive oil?	This is an example of a question that is not cross-culturally valid. It was designed to reflect part of the Mediterranean diet pattern. This question is also problematic because it has so many pieces in one question (double barreled with multiple food items listed in each)
	During the past 30 days, how many times per day did you usually eat fruit, such as [country specific examples]?	This question tries to proscribe a reference period because that is generally best practice, but it requires respondents to first think about 30 days ("is that a month?") and then "usually," which may be too cognitively difficult. It may be useful to proscribe a reference period to handle seasonality. Would be better to ask about "in the last month."
Better questions	Yesterday during the day or at night, did you eat or drink any dark green leafy vegetables?	This question is very specific and easy to answer. However the 1-day recall period is not ideal: if we want to know about usual consumption, the only logical extrapolation from this question is that people consume DGLVs "daily" or "never," and it is unlikely that either of those is necessarily true based on this question.
	In a typical week, how often do you eat fruit?	This question is quite straightforward and yields results that are directly interpretable and useful. Whether the question is reliable and whether results are accurate are other questions; See discussion below about lumping and splitting food items.
Possible response categories	○ Never or occasionally; 2-3 times/week; once/day; more than once/day ○ 0 times; about 1-2 times; about 3-4 times; almost every day; 2 or more times every day	A rule of thumb is that it is generally cognitively easiest for people to keep three things in mind at a time. Need a good compromise between cognitive ease and meaningful results.

Examples of aggregating multiple food items into the same question	In a typical week, how often do you eat fruit? In a typical week, how often do you eat vegetables? In a typical week, how often do you eat whole grains? In a typical week, how often do you eat beans? *Or even more aggregated:* In a typical week, how often do you eat fruits and vegetables? In a typical week, how often do you eat beans or nuts?	This way of asking will result in one end result we want to know about, but may be a cognitively difficult type of question for respondents to answer because it groups many distinct foods into one question. This way of asking aggregated food group question probably requires specific examples to be given. (… fruit such as [local examples]) Lumping food items into a single food group may work for fruit or beans, but perhaps less for "vegetables" which is a larger group and includes very different types of foods (e.g. salads, stews) in the same category. Whole grains: It is probably difficult for people to know what is meant by "whole grains" or if what they ate qualifies as such. This type of question cannot capture diversity within fruit and vegetable consumption, which may be a key element we need to measure.
Examples of single food questions	In the past week, I ate apples … In the past week, I ate bananas … In the past week, I ate grapes … In the past week, I ate oranges …	Without aggregation, responses are of little interpretable use. Responses could be aggregated by summing responses to all questions; this would likely result in an over-estimate of consumption (may be possible to correct based on validation studies). Responses can capture diversity in plant food consumption. The FHC-Q asked questions this way based on the most commonly consumed items within each food category of interest, which requires the questions to be designed based on in-depth knowledge of local food consumption. We would want to have the same number of questions for all respondents — for example, the four top vegetables — even though in reality there may be more or fewer that are very commonly consumed depending on the country. If there are only four commonly consumed vegetables in one country and 10 in another, the questions may better capture actual consumption in one country than another, potentially reducing comparability.

Sample questions — dietary habits screener

	Question example	Remarks
Worse questions	Do you do any of the following on a regular basis [to control your salt intake]? (Yes/No) (1) Limit consumption of processed foods (2) Avoid eating foods prepared outside the home	Neither of these is likely to be a very good question: (1) The term "processed foods" will not be understood in the same way by all respondents, so it is unclear what they are answering about (2) It is questionable whether the categorization of "prepared at home" or "prepared outside home" is a good proxy for saltiness or healthfulness.
	Thinking about the food you eat, for each of the following please say if it is something you actively try to include in your diet, something you actively try to avoid or something you don't think about either way. (Gallup poll in the U.S.)	The simplicity of this kind of question is both an advantage and a disadvantage; it is easy to analyze and interpret, but may be difficult to answer in a binary way, as the true answer may be somewhere in between. This question asks about intent rather than actual habits. It may be only crudely related to diet quality: almost everyone in the U.S. survey where this question was used reported trying to include fruits and vegetables in their diet, although most survey respondents in reality probably do not consume adequate fruits and vegetables. This sort of question is particularly susceptible to a "health halo" effect: where respondents are likely to respond positively to questions about foods they know they should eat more of.
Possibly a better question type	When I think about myself, drinking sweetened beverages is part of my daily routine. – Not true at all for me, Not true for me, Neither true or not true, Somewhat true for me, Very true for me	This question asks the respondent to respond about actual behavior rather than intent. It may therefore be closer to actual consumption behavior than the above example.

Validation

Indicators will need to be validated for assessing usual intakes of the dietary components we have underscored as key elements of diet quality. The validation can be thought of in two steps: first, we can test how a hypothetical screener performs in existing dietary intake datasets (*if we create this indicator from pre-existing data, does it correspond with diet quality and/or positive health outcomes?*), and methodological validation (*is the response to the chosen questions reliable and accurate*?). Based on both of these stages, which may be iterative to some degree, we would like to establish that the questions selected are valid proxies of diet quality, or certain elements of diet quality.

Stage 1 conceptual validation

For conceptual validation, we could use existing dietary intake datasets, create indicators based on how a person consuming the diet in the dataset would have (perfectly) responded to the survey questions, and analyze whether the indicator corresponds to positive health outcomes and overall diet quality. We assume that if indicators of the two proposed diet elements measure what they are supposed to, they *should* be related to health outcomes and overall diet quality indices, but this needs to be verified. Total intakes of the food item, based on quantitative dietary intake surveys, are considered optimal measures of dietary risk factors (Micha et al., 2012).

Key question in this stage of validation:

Is the overall concept valid? That is, are the categories, frequencies and cut-offs of the indicator(s) valid reflections of diet quality and/or health outcomes?

Cut-offs would be important to develop, indicating a positive or negative contribution to diet. The MDD-W box below illustrates how cut-offs were developed and how that indicator was validated against one diet quality index.

Questions for discussion:

- What should the indicators are validated against?
- If overall diet quality, which DQI or which pieces of diet quality?
- If health outcomes, which ones?
- We may be also interested in validation for pieces of diet quality, such as,
  - Is ultra-processed food consumption a good proxy for free sugar consumption, or salt consumption?
  - Does this set of questions about fruit and vegetable consumption reflect adequate fruit and vegetable consumption?
- Which data sets can be used for the validation? GDD and GIFT are possibilities, because they are the only clear resources with which we could ensure the conceptual validation holds across many countries/regions. Basing the validation on health outcomes necessitates the use of datasets that have both dietary intake data and health outcomes.

The MDD-W (minimum dietary diversity indicator for women of reproductive age): its validation and use for monitoring nutrient adequacy

By Terri Ballard

The MDD-W (minimum dietary diversity indicator for women of reproductive age) is a dichotomous indicator of whether or not women 15 to 49 years of age have consumed at least five out of ten defined food groups the previous day or night. The proportion of women 15 to 49 years of age who reach this minimum in a population can be used as a proxy indicator for higher micronutrient adequacy, one important dimension of diet quality. Responding to demand for a dichotomous (yes/no) indicator, MDD-W provides a threshold value of five or more of ten food groups to use as a criterion in assessments. This allows expression of the prevalence of meeting "Minimum dietary diversity for women of reproductive age" at the population level.

The MDD-W was developed based on analysis of nine quantitative food intake datasets from Africa and Asia using a common analytic protocol and relating the indicator to the micronutrient adequacy of women's diets across 11 micronutrients. The researchers assessed the probability of adequacy (PA) for 11 micronutrients, using the most recently published estimated average requirements, and constructed the "mean probability of micronutrient adequacy" (MPA), which summarizes micronutrient adequacy across the 11 micronutrients.

Validation of a wide range of "candidate" food group indicators (FGI) to derive the best performing indicators (number of food groups and thresholds) included correlations and simple linear regressions to describe relationships between each candidate FGI and energy intake, PAs and MPA. The performance of eight candidate indicators in predicting different thresholds of MPA (0.50, 0.60 or 0.70) was assessed using receiver-operating characteristics (ROC) analysis. The area under the curve (AUC) summarized the predictive power of each indicator across all possible FGI cutoffs. The researchers identified potential dichotomous indicators, according to various FGI cutoffs, by examining the sensitivity, specificity and total misclassification of those indicators associated with several thresholds of MPA. This allowed identification of a "best cutoff" for those FGIs that performed correctly (i.e. AUC ≥ 0.70) in a sufficient number of datasets and at different MPA levels.

While acknowledging moderate to poor sensitivity and specificity at the individual country level, overall, results were consistent enough to recommend the use of a dichotomous food group indicator for global use in population-level assessment and advocacy. In addition to validation results, the researchers considered the nutritional meaning of the dichotomous indicators, their possible use/misuse at the global or programmatic level and their practical advantages or drawbacks in terms of operationalization or communication for coming up with a final recommendation of the MDD-W dichotomous indicator. Comparisons within and across sites suggested that the MDD-W can be used also to track changes in dietary diversity across countries and regions, thus contributing to monitoring progress at the global level.

Stage 2 methodological validation: reliability and accuracy of selected questions

In the second stage of validation we are concerned primarily with reliability, which refers to consistency or dependability of a measure. A reliable measure would, if administered more than once, or by more than one person, have a similar result. We also want to know about accuracy — whether the responses reflect true intake, or if they are systematically biased. The indicators should be accurate reflections of the dietary component they are measuring; for example, the survey question answer about SSB consumption should reflect actual SSB consumption, and survey analysis indicating diverse plant food intake should reflect actual diverse plant food intake.

Key question in this stage of validation:

Does the question itself work — do people understand it? Is the question reliable? Are responses accurate?

Gallup has experience with cognitive testing (see box below), a qualitative process that determines whether people understand and are able to answer proposed questions. It would also be useful to have quantitative validation of the questions, which implies collecting dietary intake data and also asking the same respondents the survey questions. There may be existing efforts that will collect new dietary intake data which would be open to piloting a set of survey questions for these new indicators.

Cognitive testing of questions at Gallup

The purpose of a cognitive interview is to evaluate sources of response error in a survey questionnaire, and to ensure the questionnaire items are clear, easy to interpret and focused on eliciting the desired information from respondents. During cognitive interviews, the following concepts are tested: question comprehension, memory retrieval of relevant information, decision processes and response processes:

1. Question Comprehension
    a. Intent: What does the respondent believe the question is asking?
    b. Meaning of Terms: What do specific words and phrases in the question mean to the respondent?
2. Memory Retrieval of Relevant Information
    a. Ability to recall information: What types of information does the respondent need to recall in order to answer the question?
    b. Recall Strategy: Type of strategy a respondent employs (ex: does the respondent tend to count the number of hours that he/she worked last week by thinking about each day of the week individually or does he/she use estimation strategy)?
3. Decision Processes
    a. Motivation: Does the respondent devote sufficient mental effort to answer the question accurately and thoughtfully?
    b. Sensitivity/Social Desirability: Does the respondent want to tell the truth? Can respondent tell the truth? Does he/she say something to make him/her look better?
4. Response Processes
    a. Mapping the Response: Can the respondent match his/her internally generated answer to the response categories given by the survey question?

The interviewers mostly utilize verbal probing techniques. Additionally, a “think out-loud” technique will be used if there is a need to describe a very specific type of activity (for example, “How many times have you accessed the internet in the last seven days?”). In this case, the interviewer will ask the respondent to “think-out loud” as he/she answers the survey question. Both verbal probing and think-out-loud techniques help the researchers improve questions and minimize response error.

In addition to cognitive interviews pilot testing of the questionnaire pre-implementation across a diverse group of the target population is necessary to identify and correct any problems that may occur prior to conducting the full study. Pilot testing ensures that there are no unforeseen translation problems, instructions are clear, skip patterns are correctly defined and that those patterns may be easily followed.

Adaptation

Part of the work to ensure the indicators are valid will be adaptation with local food examples. The FIES box below describes how adaptation was done to ensure culturally-appropriate language and validity within the Voices of the Hungry Project. The MDD-W measurement guide provides examples of foods commonly consumed in survey areas, which may be helpful to start adapting the questions here (FAO and FHI 360 2016).

Adaptation of the Food Insecurity Experience Scale in GWP
By Terri Ballard

The FIES was piloted in 2013 in GWP surveys in four African countries after carrying out extensive qualitative research in each country to linguistically and culturally adapt the eight FIES items into survey languages. The goal of the qualitative work was to produce translated FIES items with the same conceptual meaning as those in English, but that were expressed in ways that were understood within the cultural context. This work contributed to producing a linguistic guide with synonyms and alternative phrasing that translators can refer to when translating from the FIES questions. This guide is used by GWP country teams to translate the eight FIES questions (along with the entire GWP survey questionnaire) into survey languages. The FIES translations are evaluated by the VoH analysts each year by checking for single items that appear to have been responded to in unexpected patterns. Also, the GWP country teams each year review the translations against the linguistic guides and make adjustments as needed.

Proposal and Key Discussion Points

This paper has outlined the need for monitoring diet quality, why Gallup World Poll is a feasible and in some ways optimal vehicle to do so, what are the key elements of diet that should be measured as indicators of diet quality and how they can be measured.

From the analysis, we propose:

1. Diet quality should be monitored globally and is needed for basic information about health and nutrition as well as policy decisions.
2. Gallup World Poll is a feasible vehicle to track indicators of diet quality; other means are needed for comprehensive measurement of diet quality. We are striving for something that is not necessarily comprehensive but that provides a strong enough barometer of diet quality for policy action.
3. The two most indisputable elements of diet quality, with large effects on health outcomes and agreement across guidelines, are:
    a. Consumption of diverse plant foods (fruits, vegetables, whole grains, legumes, nuts)
    b. Consumption of ultra-processed foods (including sugar-sweetened beverages, processed meats, and other components such as packaged salty snacks, dried packaged soups, packaged sugary snacks).
4. These two elements of diet quality can and should be measured in GWP.
5. These two elements of diet quality are appropriate and meaningful to measure across countries; they are universally important across regions, countries, including those in which diets are rapidly transitioning.
6. These two elements of diets also are consistent with sustainable diets, which is important in light of global recognition and commitments toward sustainable food systems.
7. In measuring plant food consumption, both amount and diversity are important.
8. In measuring ultra-processed food consumption, sugar-sweetened beverages and processed meats should be captured.

Points of discussion:

1. What is the best way to categorize the identified key elements of diet quality, taking into account meaningful interpretation?
    a. Discuss the interpretation of indicators or metrics and the political implications of how this research could be used to inform policy — what do policymakers need to work with to make changes?
2. What is the best method for capturing information about the key elements of diet quality? (see Table “Comparison of possible methods”)
    a. Discuss: Do the methods have to be the same for diverse plant foods and UPFs?
3. In validating indicators, we propose a two-stage process: (1) testing the conceptual validity of potential indicators within an existing dietary intake survey, and (2) testing the reliability of questions for promising indicators.
    a. Discuss: What should the indicators be validated against? If overall diet quality, which DQI or which pieces of diet quality? If health outcomes, which?
    b. Discuss: Which datasets can be used for validation? Is it possible to work with GDD and GIFT on this? Other options?
    c. Are there ongoing initiatives with which we could partner to validate the reliability of questions?

4. What is the best way to adapt questions to local contexts to maximize cross-cultural validity? (Note: answering this will be more straightforward once we decide on the methods to be used.)

In conclusion, the “why, when, who and what” to measure is relatively clear, while the “how” requires more discussion and work to be done. It is clear why we need to measure diets. There is no reason to delay work on this topic; after decades of relative inaction, its time has come. The Gallup World Poll is an attractive option for monitoring of diets globally, as at least one contributor. As for what to measure, we have chosen the two elements of diet for which there is overwhelming agreement among definitions, guidelines and evidence on diets and health outcomes: diverse plant foods and ultra-processed foods. Multiple methods exist for measuring these elements of diet, but with varying levels and types of validation, laying out no clear model to follow. How the nutrition community moves forward to monitor diet quality will require innovation and collaboration. With partnership and luck, scholars and leaders will soon be able to use diet quality monitoring data routinely, and will find it hard to believe that, until the late 2010s, diet quality was not yet monitored.

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Annex 1: Diet-Disease Relationships That Form the Basis for GBD Estimates

Table 3 Diet–disease relationships identified to date based on either convincing or probable evidence for a causal effect[a]

Dietary risk factors	*CVD outcomes*	*Cancer outcomes*
Foods		
Fruits	CHD, stroke	Mouth, pharynx, larynx, esophagus, lung
Vegetables	CHD, stroke	Mouth, pharynx, larynx
Whole grains	CHD, diabetes	
Nuts	CHD	
Red meats, unprocessed	Diabetes	Colorectal
Processed meats	CHD, diabetes	Colorectal
Milk	Diabetes	Colorectal
Sugar-sweetened beverages	Body mass index, diabetes	
Nutrients		
Polyunsaturated fat replacing saturated fat	CHD	
Seafood omega-3 fatty acids	CHD, stroke	
Trans fats	CHD	
Dietary fiber	CHD	Colorectal
Dietary sodium	Blood pressure, stroke	Stomach
Dietary calcium		Colorectal, prostate

Abbreviations: CHD, coronary heart disease; CVD, cardiovascular disease.
[a]Future reports will present the full supporting evidence and best available estimates of the effect size (relative risk) of the causal diet–disease relationships identified. Additional dietary risk factors currently being evaluated include beans/legumes, plant omega-3 fatty acids and dietary cholesterol; as well as other potential causal diet-disease relations for the foods and nutrients listed above.

Source: Reproduced from Micha et al., 2012

Annex 2: Analysis of Top Dietary Risk Factors by Region

Analysis by author of top dietary risk factors by region; # denotes the order of the risk factor (e.g. #1 = #1 risk factor in that region). Bottom row is a count of how many regions have each risk factor within their top three dietary risk factors.
Data source: IHME GBD-Compare tool

	Low fruit	High sodium	Low whole grains	Low vegetables	Low nuts and seeds	Low omega-3	Low fiber	High processed meat	High SSB
	Global #1	Global #2	Global #3	Global #4	Global #5	Global #6	Global #7	Global #8	Global #11
	Developing #1	Developing #2	Developing #3	Developing #4	Developing #5				
	Developed #2	Developed #1	Developed #3	Developed #5				Developed #4	
1	SSA #1	SSA #2	SSA #4	SSA #3	SSA #5				
2	SA #1	SA #2	SA #3	SA #4		SA #5			
3	SEA #1	SEA #4	SEA #2	SEA #3	SEA #5				
4	CEEECA #2	CEEECA #1	CEEECA #3	CEEECA #5				CEEECA #4	
5	MENA #3	MENA #1	MENA #2	MENA #4		MENA #5			
6	East Asia #2	East Asia #1	East Asia #3		East Asia #4		East Asia #5		
7	Oceania #2		Oceania #1	Oceania #4	Oceania #3		Oceania #5		
8	HIC Asia Pacific #2	HIC Asia Pacific #1	HIC Asia Pacific #3	HIC Asia Pacific #4	HIC Asia Pacific #5				
9	Australasia #2	Australasia #4	Australasia #1	Australasia #3	Australasia #5				
10	W Europe #2	W Europe #1	W Europe #5	W Europe #4				W Europe #3	
11	North America #1	North America #2	North America #4	North America #5				North America #3	
12	Southern LA #1	Southern LA #4	Southern LA #5	Southern LA #2	Southern LA #3				
13	Caribbean #2		Caribbean #1	Caribbean #4	Caribbean #5				Caribbean #3
14			Central LA #2	Central LA #4	Central LA #5			Central LA #1	Central LA #3
15	Andean #1	Andean #4	Andean #2	Andean #3	Andean #5				
sum	14	8	11	5	2	0	0	3	2