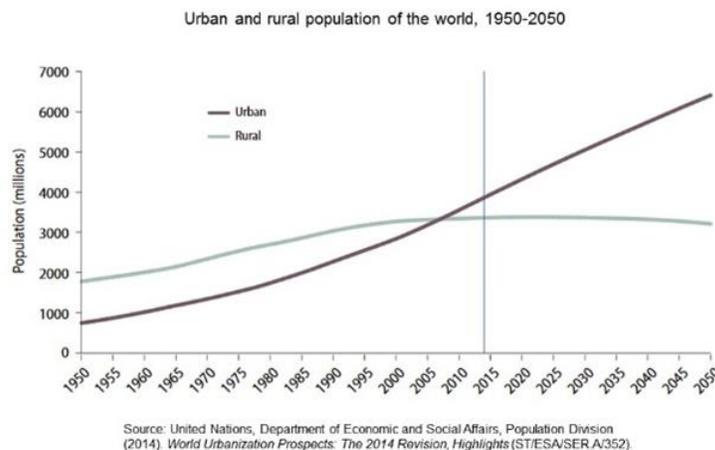


Feeding the World: One at a Time

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With a world population of ~7.5 billion, estimated by the [United Nations](#) to reach 8.3 billion in 2030, it will become ever more difficult to provide access to food, materials, and energy. Despite enormous investments and advances in food production and distribution systems, many people are faced with food insecurity, a lack of potable drinking water, insufficient sanitation, and lack of access to education and healthcare. In some geographies, it will be particularly difficult to resolve quality of life and health-related challenges associated with food insecurity, conflict, and aging demographics.

As people choose to live in urban communities, city sprawl increases and agricultural land is lost. Urbanization reduces the proximity and availability of productive agricultural land. Simply, people living in urban areas cannot locally source all their foods and a robust, sustainable, agri-food production and distribution system is essential. In an increasingly connected world where social networks can be extremely disruptive, the need for innovative solutions to solve global hunger and malnutrition in a growing population has never been so critical.



Size of the Problem

Worldwide, 2 billion people are malnourished. They are malnourished because they cannot access or afford sufficient nutritious foods. Living with a chronic shortage of vital nutrients is called hidden hunger. Malnutrition during pregnancy and the first years of a child's life translates into an economic burden for countries, costing billions of dollars in lost productivity and avoidable health care costs. Among those under 5 years of age, 3.1 million children die annually because of undernutrition (45% of all child deaths under 5y). In fact, a lack of nutrients essential for normal growth and development stunts 1 in 4 children.

Even among the overweight or obese, many suffer from hidden hunger because their diet lacks nutrients essential for growth, development, maintenance, and physiologic states such as

pregnancy and lactation. Vitamins, minerals, and others such as omega-3 fatty acids (eicosapentaenoic acid [EPA] and docosahexaenoic acid [DHA]), lutein and zeaxanthin) need to be consumed for normal cellular function.

History

Vitamins were discovered over 100y ago. Once humans learned how to manufacture vitamins commercially, it was possible to enrich and fortify staple foods. With large-scale production, the risk of deficiency diseases such as rickets (vitamin D enriched milk), goiter (iodized salt), and neural tube birth defects (mandatory folic acid fortification of flour) was reduced. Increasing dietary intake, by fortification or supplementation, prevented anemia (iron), beriberi (vitamin B1), pellagra (vitamin B2), and vitamin B3 deficiency. The role of nutrients in preventing deficiency diseases and maintaining health is unequivocal.

Because excess food consumption in conjunction with physical inactivity causes energy imbalance associated with weight gain, hyperlipidemia, poor glucose regulation (diabetes), and hypertension, there has been a tremendous focus on macronutrient intake, especially quantity and types of fat and carbohydrate. Unfortunately, the contribution of insufficient intake of vitamins, minerals, EPA, DHA, lutein, zeaxanthin, and other bioactive ingredients on health outcomes in the overweight and obese is still unknown.

Nutrition Policy

The goal of nutrition policy is to help guide people to make healthier food choices. Nutrient needs vary as children grow, women become pregnant and/or lactate, and physical activity levels change in adulthood. In animal production, farmers feed rations specifically formulated to provide the right combination of nutrients, e.g. rations for lactating dairy cows, growing pigs, or laying hens. These nutrient combinations are based on scientific measurement.

Since few randomized controlled trials have been conducted in humans, dietary recommendations are derived from historical use of staples (grains, vegetables, fruit, dairy, and protein – usually animal) to make food and are sprinkled with food belief systems. With the discovery of vitamins 100 y ago, human nutrition policy began promoting food groups. The intent was to address nutrient deficiencies by encouraging the consumption of foods, usually staples, which were naturally-rich, enriched, or fortified with vitamins and minerals.

Since 1980, the US government has issued [Dietary Guidelines for Americans](#) every 5 years. Despite repeated education programs emphasizing the importance of fruit and vegetables, the number of servings consumed daily remains low. Dairy consumption (fluid milk) is declining. People experiment with low carbohydrate diets, low fat foods, and avoid foods with added sugar

or gluten. Yet the proportion of the US population consuming recommended nutrient intakes has not changed over the past decades. How can this be?

One reason is improvements in production, storage and distribution of nutritious foods is helping consumers buy fresher, high quality, nutritious foods all year long. In addition, the addition of vitamins, omega-3 fatty acids, and other nutrients to staples, partially- and wholly-prepared foods is increasing nutrient density. Because of these advances in food technology, it is no longer necessary to associate a nutrient with a predominant food or food group. Milk isn't the primary dietary source of vitamin D and calcium. Vegans have an increasing number of non-meat food options with iron and vitamin B12. In fact, the breadth of food choices and nutrient compositions verge on infinite. With so many tasty, low cost, convenient options, hidden hunger should be non-existent.

Today's Reality

Currently, people are advised to follow dietary recommendations that integrate culture and nutrient density. Personal favorites are imprinted in childhood along with learned preferences for taste, cost, and convenience. People shouldn't be judged by the foods they eat. Nutrition policy should help avoid hidden hunger and prevent nutrient-related non-communicable diseases.

Feeding the world will require a robust, adaptable agri-food system. Nutrition information, oftentimes misinformation, regarding the healthfulness (or harmfulness) of certain food ingredients and sustainability of unfamiliar agri-food practices circulates on the internet and in social media. The cacophony of food beliefs can be overwhelming. Physicians do not prescribe drugs based on records of dietary intake and physical activity coupled with statistics on the probability of a person of a certain age and sex being hyperlipidemic. Blood lipids are measured and then drugs are prescribed (if needed). Why should nutrition guidance be any different?

Nutrition Status Measurements

It is time to change the nutrition dialogue from an obsession about 'what we put into our body' to objective measures of 'nutritional status'. People measure their weight routinely. Health assessment includes blood lipid and blood glucose measurements. By measuring blood levels of vitamins and EPA+DHA, i.e. by knowing status, one can be guided to make data-driven dietary changes. Startup companies such as VitaScan.me can quantitatively measure vitamin D status from a single drop of blood in 10 minutes. The same can be done with blood ferritin, B12, or vitamin A. Think about having 4 nutrients assessed and learning that only nutrient, e.g. iron, was in an insufficient range (i.e. anemic). And being assured that one's vitamin D status was sufficient. By knowing one's nutritional status, it is possible to make dietary changes, or stay the

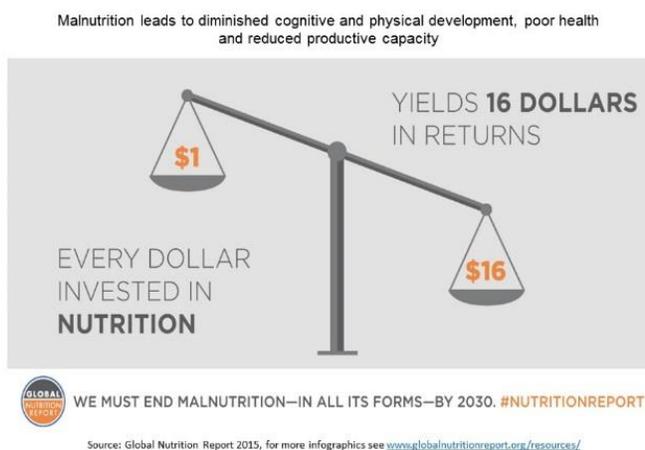
course. Individuals can find relief from nutrient-based food concerns. Personal beliefs can be accommodated. The person with iron anemia can be presented with options: eat more red meat, iron-rich plant foods, and/or use an iron supplement. The choice is personal and can be devoid of food bias. A follow-up test will confirm if iron status was repleted or not. In this example, the individual can find peace of mind knowing his/her vitamin B12, A, and D status was sufficient.

A second example; my wife and I eat salmon 3-4 times per week. We are exceeding the [‘at least two servings per week’ recommendations of the American Heart Association](#). Nevertheless, upon assessment, our [omega-3 index](#) was far below the 8% recommended for cardioprotection. Our options were to eat more fatty fish or use a fish oil supplement. Because of concerns about mercury intake, we chose to use a fish oil supplement. It was our choice.

Hidden hunger is a global issue. In the US alone , [>95% of Americans have suboptimal blood levels of omega-3 fatty acids](#), EPA and DHA, for cardiovascular health. More than 80% of Americans are not consuming recommended amounts of vitamin E, explaining the [suboptimal serum α-tocopherol concentrations measured in 62% of American adults](#). Sixty-four percent of Americans have serum vitamin D concentrations below 75 nmol/L recommended by the [International Osteoporosis Foundation](#). If every US women over 55y with osteoporosis were to consume recommended preventative daily intakes of 800 IU of vitamin D and 1000 mg calcium, [>1.2 million medical events could be avoided with a US health care savings of >\\$8 billion over 7 years](#). Every dollar invested in nutrition, i.e. preventing hidden hunger, yields 16 dollars in returns.

Call to Action

Nutrition policy should shift from measuring food intake to measuring nutritional status. By knowing blood levels of vital nutrients, individuals can find dietary solutions to maintain their health. Researches can investigate the extreme cases where deficiency or excess is observed to find out if educational or regulatory action is needed. Annual status monitoring of individuals would enable communities to prevent nutrient-dependent chronic diseases. As stated in the [2015 United Nations Sustainable Development Goals](#), ensuring healthy lives and promoting well-being at all ages is essential for sustainable



development. To feed 8.3 billion people efficiently, it is time to invest in promising innovative technologies to assess nutrient, i.e. vitamin, mineral, EPA+DHA, lutein and zeaxanthin, status.



Dr. Michael McBurney is one of the world's leading nutrition authorities. He has published >80 peer-reviewed papers, 10 book chapters, 36 proceedings and letters, and 101 technical abstracts. He is an Adjunct Professor in the Friedman School of Nutrition Science & Policy at Tufts University, has held academic appointments at the University of Toronto, University of Alberta, Michigan State University and was founding Department Head of the Department of Nutrition and Food Science at Texas A&M University. Currently, Michael is VP Science, Communications & Advocacy at [DSM Nutritional Products](#) where he provides global

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He is an active volunteer with leadership experience in the American Society for Nutrition (ASN), Institute for Food Technologists (IFT), International Food Information Council (IFIC), International Life Science Institute (ILSI), Council for Responsible Nutrition (CRN), Canadian Nutrition Society (CNS) and New York Academy of Science (NYAS). He served as a founding Advisory Board member of the Institute of Nutrition, Metabolism and Diabetes within the Canadian Institutes of Health Research. He is a member of the National Association of Science Writers and current chair of Cornell University Division of Nutrition Sciences External Advisory Board. He is an industry representative (non-voting member) of the FDA Food Advisory Committee.

Dr. Michael McBurney received his B.S. in Biology (Ecology) from Carleton University and M.S. and Ph.D. degrees in Nutrition from Cornell University. Accreditations include professional mediation ([Texas Mediation Training Roundtable](#)) and Executive Leadership I, [IMD Business School](#).

Follow him on twitter [@MIMcBurney](#) and [LinkedIn](#).

Greg McParland, Senior Investment Manager at DSM Venturing will chair the investor debate *Beyond the Hype – Where is the Next Big Disrupter in the Food Industry?* at [Future Food-Tech New York](#) on June 7-8.