

FOCUS ON
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LATIN AMERICA
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ISSUE
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Sight and Life

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- > There are 22 countries on the main continent and 28 countries and territories in the Caribbean
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- > 534 million people live in the region, representing 13% of the world's population
.....
- > 79% of Latin Americans live in urban settings
.....
- > Spanish and Portuguese are the two main languages. Other languages include Quechua, Aymara, Guaraní, Nahuatl, English, French, and Dutch

Relevant facts about Latin America and the Caribbean



Welcome

Nutrition for a More Equitable Society

I joined the *Sight and Life* team in November 2012 and I am very happy to support our global operations from our office in Kaiseraugst, Switzerland. In my current position as Scientific Manager, part of my role is to be a knowledge broker, and *Sight and Life* magazine is a key tool for disseminating knowledge. It is for this reason that I am extremely pleased to introduce this second issue with its special focus on Latin America and the Caribbean (LAC), where I have had the pleasure to live, work, and travel extensively. Latin American researchers are leaders in nutrition, and we are delighted to showcase some of the top minds in the field. I hope you will enjoy this brief treatise on the success and challenges for nutrition in LAC.

Progress and challenges in nutrition in LAC

Significant gains have been achieved in nutrition in LAC. Extreme poverty (living on less than US\$1.25 a day) fell from 12% in 1990 to 5% in 2010.¹ The reduction in child mortality has also been significant, from 53 per 1,000 live births in 1990 to 19 in 2010.¹ Also, there has been a 48% reduction in stunting in the region.² Vaccination for measles is almost at universal coverage on the main continent and at 76% coverage in the Caribbean. In regard to social development, the region has taken a particular interest in nutrition, placing this as a key activity for conditional cash transfer programs. Of the 15 programs currently underway in the region, 10 have specific nutrition co-responsibilities (Table 1).

“The statistics showcase success, but many challenges lie ahead”

Although these statistics showcase success, many challenges lie ahead, including regional disparities, the double burden of malnutrition, and health inequities. For example, the infant mortality rate in Cuba is 4.8 per 1,000 live births, while in Bolivia it is 50 per 1,000 live births.³ In Guatemala, 48% of children <5 years old are stunted,² while in Mexico the prevalence

is 15%. And even within Mexico, there are large regional disparities in stunting, with many southern states showing a prevalence of $\geq 20\%$, while some northeastern states demonstrate a prevalence of $< 5\%$.⁴

The impressive economic development in the region has caused a dramatic shift in the food system, with repercussions for agriculture practices, the movement of rural population to urban settings, and access to high-fat, high-sugar processed foods. Consequently, the epidemiological profile has shifted, with overweight and obesity manifesting themselves in alarming proportions among women of child-bearing age, while stunting in young children continues to be a public health issue. For example in Mexico, in 2006, 72% of women ≥ 20 years were overweight or obese, and about 10% of children between the ages of 12 and 23 months were overweight (> 2 SD mean WAZ), while 15% of children under two years of age remained stunted.⁵ The high burden of malnutrition disproportionately affects indigenous communities, families in rural areas, and those with poor education and with poor access to basic services. Children born into these families begin life with a disadvantage, which makes it extremely difficult for these children to realize their full potential.

“A delivery science approach in nutrition can contribute to our collective human development”

Advocacy for equity

Equity can be defined as having access to services one requires to achieve well-being. Unlike equality, whereby everyone is granted equal access, equity tips the balance in favor of those who are most vulnerable. Recently, the World Bank has developed the Human Opportunity Index to quantify inequities of opportunity for children. This index measures the coverage of basic services and whether these services are distributed to those most in need.⁶ Conversations about equity and opportunity are relevant to nutritionists because we have much to contribute to these discussions. If opportunity can be measured through

TABLE 1: Conditional cash transfer programs in Latin America with nutrition as a specific co-responsibility.^a

Program	Country	Nutrition-related services	Target group
Bolsa Alimentação	Brazil	Growth monitoring Nutrition education	Children 0–15 years Pregnant women
Familias en Acción	Colombia	Growth monitoring	Children 0–6 years
Solidaridad	Republica Dominicana	Growth monitoring	Children 0–5 years
Bono de Desarrollo	Ecuador	Growth monitoring	Children 0–5 years
Red Solidaria	El Salvador	Growth monitoring Nutrition education	Children 0–5 years Pregnant women
PRAF II	Honduras	Growth monitoring	Children
Oportunidades	Mexico	Growth monitoring Nutrition education Iron and food supplements	Children Adults
Red de Protección Social	Nicaragua	Growth monitoring Nutrition education Iron supplements	Children 0–5 years
Tekopora Program	Paraguay	Growth monitoring	Children 0–14 years
Juntos	Peru	Growth monitoring Nutrition education	Children 0–5 years Pregnant women

^aAdapted from Basset (2008). Can conditional cash transfer programs play a greater role in reducing child undernutrition? SP Discussion paper 0835. Washington, DC: World Bank

program coverage and distribution of proven interventions to vulnerable target groups, then a delivery science approach in nutrition will contribute to our collective human development. Delivery science focuses on how to deliver interventions with high coverage and adherence. And adherence to interventions has a lot to do with the quality of health information as well as participants' cognitive decision-making process about health behaviors, including how they incorporate new information into their existing knowledge frameworks.

Finally, in thinking about opportunities, I would like to make a last remark. Malnutrition is a socially constructed phenomenon, organized around income, gender, education, and ethnicity. Advocacy for nutrition must be advocacy for equity, and for eliminating the broader social factors that continue to feed malnutrition as a social problem.

With warm regards,



Eva Monterrosa

References

01. The Millennium Development Goals Report. New York: United Nations, 2013. Available at www.un.org/millenniumgoals/pdf/report-2013/mdg-report-2013-english.pdf.
02. Improving Child Nutrition. Report. New York: UNICEF, 2013.
03. Health in the Americas. Regional outlook and country profiles. Washington DC: PAHO, 2012 p. 1–40
04. Shamah-Levy T, Villalpando-Hernández S, Rivera-Dommarco JA. Resultados de Nutrición de la ENSANUT 2006. Cuernavaca, México: Instituto Nacional de Salud Pública, 2007 (Nutrition results of ENSANUT 2006. Cuernavaca, Mexico: National Institute of Public Health, 2007).
05. Flores-Huerta S; Klunder-Klunder M, and Muñoz-Hernandez O. Physical growth and nutritional status of Mexican infants from newborn to two years of age. *Salud pública Méx* 2012, vol.54, suppl.1: s82–s89
06. Barros RP, Ferreira, FH, Molinas-Vega J, and Saavedra Chanduvi J. Measuring inequality of opportunities in Latin America and the Caribbean. Washington, DC: World Bank, 2012.

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Would you like to learn more about micronutrients? Do you wish to update your understanding, test your memory, fill in your knowledge gaps? Then why not try the online *Sight and Life* Micronutrient e-Learning Course? It's free, it's authoritative, and it's available 24/7 from www.sightandlife.org.

User-friendly and accessible

This newly created course is targeted at individuals who are interested in nutrition or who work in an environment where micronutrients play an important role. It has been designed to be user-friendly and accessible to non-nutrition specialists.

Key information and insights

The primary aim of the course is to improve the student's understanding of 17 key vitamins and minerals. The course is divided into modules, each of which provides an introduction to the relevant vitamin or mineral, a description of its role and functions and its utilization by the body, and an account of the consequences of deficiency and excessive consumption. Depending on the specific micronutrient, the modules take between 20 and 35 minutes to complete.

Keeping you on track

Each module explains the public health implications of deficiency in the respective micronutrient and delineates interventions for addressing such deficiencies. It also describes the value of scaling up initiatives to address the deficiencies in question. The modules may be studied in sequential or non-sequential order, depending on the student's individual preference. Extremely user-friendly, the course also offers auto-evaluation tools that help the student to track progress and check his or her understanding of the material presented.

Getting started

It's easy to get started with the *Sight and Life* Micronutrient e-Learning Course. All you have to do is:

- > go to www.sightandlife.org;
- > register (if you have not registered already);
- > click on e-Learning in the menu at the top of the homepage; and
- > start learning!

Kalpna Beesabathuni, India Country Head, *Sight and Life*

India: What Matters Is Access to Food and Nutrition



I write in response to issue 1/2013 of this magazine, and in my capacity as India Country Head, *Sight and Life*.

India's battle against malnutrition has been a widely recognized challenge. Achieving food security is a popular way of addressing this challenge. The focus of food security in India has previously been on food availability rather than assuring dietary quality, and with significant government support, India was able to achieve self-sufficiency in this area. However, this led to the problem of a surplus of food grains to the extent that storage became an issue, resulting in the rotting of large quantities of grain.

Access to nutrition

In the words of Amartya Sen, the Indian philosopher, economist, and Nobel Laureate, "What really matters with food is not the overall supply, but individual access." Food-based interventions such as the Public Distribution System (PDS), Integrated Child Development Services (ICDS), and Mid-Day Meal Scheme (MDM) were introduced by the Government of India to meet the energy needs of the nation's most vulnerable populations. These services are centrally sponsored and administered by individual states. While the PDS is a farmer price support and consumer subsidy program for food grains, the ICDS focuses on meal supply to preschool children and their mothers, and the MDM targets children of school age in order to improve enrollment and attendance in government schools. The ICDS has also been a channel for immunization and health and nutrition education. Utilization of the universal vitamin A supplementation (VAS) program, folic acid supplementation, and immunization services is also seen to be improved in regions with robust ICDS.

"The magnitude of malnutrition present in India continues to baffle us all"

Inequity despite economic growth

Despite targeted and universal interventions, the magnitude of malnutrition present in the country continues to baffle us all. Last year, Save the Children introduced "The Nutrition Barometer," a measure of the progress made by 36 developing countries with the highest levels of child undernutrition. India ranked among the bottom three countries according to the Barometer, along with Yemen and the Democratic Republic of Congo. This rating was based on India's continued inadequate and weak political, legal, and financial commitments, and persistently low outcomes. Interestingly, India's neighbors Bangladesh and Nepal have outperformed India despite possessing only half and one third of India's per capita income respectively.

According to the United Nations Development Programme (UNDP) Human Development Report and the World Bank's World Development Indicators, India went from second best in the South Asian region in 1990 to second worst in 2010. For example, let us review India's under-five mortality rate (U5MR – a measure of the number of deaths per 1,000 children under the age of five). India's U5MR decreased only from 115 to 63 in comparison with Bangladesh's reduction from 143 to 48, and Nepal's from 141 to 50.

India's impressive economic growth has therefore yet to be translated into a fair level of economic development, equity and improved nutrition for its most vulnerable populations. The country has not been able to expand or improve resources for its state-supported nutrition programs. Along with scaling up these programs, it is important to improve their quality, especially in terms of broadening their scope from merely providing calorie intake to providing a balanced, nutritious diet. Similar improvements are required in maternal education, preventive healthcare, hygiene, and sanitation.

There are, however, some successful examples of non-governmental organizations (NGOs) that prepare diversified mid-day

Key statistics of food-based interventions in India

Intervention	Key statistics
Public Distribution System (PDS)	<ul style="list-style-type: none"> > 26 million tons of wheat grain and 32 million tons of rice > Government spending: US\$13.6 billion per year > Reach: 500,000 shops
Mid-Day Meal Scheme (MDM)	<ul style="list-style-type: none"> > 110 million children in 1.2 million government schools > 570,000 kitchens > 2.4 million kitchen staff
Integrated Child Development Services (ICDS)	<ul style="list-style-type: none"> > More than 4.8 million pregnant and lactating women reached > More than 23 million children under six years old reached > More than 1.3 million ICDS centers

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“India’s impressive economic growth has yet to be translated into improved nutrition for its most vulnerable populations”

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meals (MDM) fortified with eggs, soy protein, and micronutrients in collaboration with government, private sector, and civil society partners. Other NGOs address social and gender imbalances through education and capacity-building programs to empower women to address the vicious cycle of undernutrition. Another interesting trend is that of decentralizing decisions and actions through state nutrition missions and the National Rural Health Mission, which take into consideration regional sociocultural differences while designing and implementing programs. We need more such cross-sectoral collaborations at the regional level to effectively develop and deploy resources towards achieving food and nutrition security. In the words of David Nabarro, Special Advisor to the United Nations Secretary General, “Economic development depends on human capital development, and that depends on nutrition.”

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Klaus Kraemer, *Sight and Life*

The Stunting Enigma



“Globally, 165 million under the age of five are stunted as a result of malnutrition. This is the face of poverty,” said Jim Yong Kim, President of the World Bank Group, on June 6 in a press release entitled “World Bank Group scales up support for global nutrition programs in response to stunting crisis, food price volatility.”¹

Stunting (defined as ≤ 2 standard deviations below the mean height-for-age) is a widespread phenomenon in developing countries. According to the 2013 Lancet series on Maternal and Child Nutrition,² 90% of the stunted children under the age of five years live in just 34 countries. The good news is that since 1990 there has been a steady decline in stunting. Nevertheless, the current rate of reduction is still too slow to reach the target set at the 65th World Health Assembly (WHA)³ in 2012 – no more than 100 million stunted children under the age of five by 2025. Shortly after the WHA, the European Development Commissioner, Andris Piebalgs,⁴ pledged to provide funding to prevent 7 million children from stunting, about 10% of the WHA target. In addition, the signatories to the Global Nutrition for Growth Compact⁵ in June this year committed their countries and organizations to reducing the number of children under five who are stunted by an additional 20 million by 2020. The recent 2013 UNICEF report⁶ entitled *Improving Child Nutrition* also focuses on stunting prevention, and the important report of the High-Level Panel of Eminent Persons⁷ endorses stunting as a food and nutrition target for the Post-2015 Development Agenda. No doubt about it: Stunting is high on the global health and development agenda.

According to paper 2 in the 2013 Lancet Maternal and Child Nutrition Series, a 20% reduction in stunting is expected when 10 evidence-based direct nutrition interventions are taken to scale with 90% coverage in the 34 countries with the highest stunting burden. However, reaching 90% coverage will be quite

a challenge, and will still only result in a 20% reduction of the global stunting burden.

“Stunting is a complex and still poorly understood phenomenon”

The reality is that stunting is a complex and still poorly understood phenomenon, and while good nutrition during the first 1,000 days of life plays an important role, it is not the only factor involved. This was recognized in the first UNICEF Conceptual Framework for the prevention of malnutrition, which was developed in the 1980s. This Framework acknowledged that inadequate care, insufficient health services, and an unhealthy environment were also key contributors to malnutrition and thus to stunting. But why has progress in stunting reduction not been faster and more significant, given that the root causes were hypothesized in the 1980s?

I believe that “undernourishment” as a target for Millennium Development Goal (MDG) 1 has distracted significantly from nutrition outcomes. Merely counting the people that have to survive on less than 2,100 kcal per day (derived from FAO food balance sheets) may guarantee food security, but it certainly does not ensure nutrition security. This is recognized by the fact that food and nutrition security have become inextricably linked in our discourse and we no longer talk of the one without the other. *Sight and Life* recently published a paper on the Hidden Hunger Index,⁸ in which we found a strong correlation ($r = -0.88$) between the Hidden Hunger Index (HHI) and a low Human Development Index (a composite measure of three basic dimensions of human development) but much weaker correlations ($r = 0.56$) between undernourishment and HHI. This highlights the fact that undernourishment does not adequately reflect the degree of hidden hunger in a population.

“Economic development alone is not sufficient to drive down stunting rates”



Socioeconomic status is a major risk factor for stunting, but we know that economic development alone is not sufficient to drive down stunting rates quickly enough, or to reduce the prevalence to sufficiently low levels, because economic prosperity is distributed unequally across societies. Countries with the biggest improvements in nutrition in recent years have experienced rapid economic growth but still experience significant nutrition and health disparities. The recent outcry against corruption and the poor quality of public services by millions of Brazilians during the 2013 FIFA Confederations Cup is an impressive example that economic growth does not reach all. Even a country that has been praised for its successful government program to end undernutrition (*Fome Zero* – Portuguese for “Zero Hunger”)⁹ needs to address disparities more seriously.

Importantly, economic development can also have undesirable consequences, such as increased obesity rates, for example. A 10% rise in GDP per person leads to a 6% reduction in stunting, while increasing overweight and obesity in women by 7%. A key message that needs to be stressed is that preventing undernutrition during the first 1,000 days is critical for optimal growth and development and also for reducing the risk of developing non-communicable diseases (NCDs) later in life. This observation from Lancet paper 1 requires careful attention, as under- and overnutrition can no longer be regarded as two distinct issues requiring separate interventions. It is for this reason that Lawrence Haddad of the Institute of Development Studies proposes dropping the “double” from the commonly referred to “double burden of malnutrition” – a suggestion that deserves careful consideration!

The dirty chicken hypothesis¹⁰

What else other than fetal growth restriction/low birth weight, suboptimal breastfeeding, and inadequate complementary feeding causes stunting?

Farmers have known for a long time that chickens raised in unhygienic conditions grow poorly compared with those living in a sanitary environment, and that proactively adding antibiotics to the diet of the “dirty” chicks boosted their growth to within the normal range. In comparison, diarrhea (often as a result of an unhygienic environment) has been claimed to contribute to childhood stunting. In a multi-country analysis¹¹ of the effects of diarrhea on stunting in children below the age of two years, 25% of the stunting burden was attributed to more than five episodes of diarrhea. Yet open defecation is still common for 1.1 billion people. In a study among rural and urban families in Indonesia, a lack of improved latrines was associated with a child history of diarrhea in the last seven days (OR = 1.23) in addition to increased under-five mortality risk.¹²

But it is not only diarrhea that contributes to stunting: Chronic infections and inflammation of the intestine, not causing diarrhea but affecting nutrient absorption and possibly causing “leakage” of bacteria into the bloodstream, can also have this effect. This phenomenon is called environmental enteropathy (EE).¹³ It causes hyperstimulation of the gut immune system from ingested fecal bacteria that might also lead to systemic inflammation with increased pro-inflammatory cytokines (interleukin-6, tumor necrosis factor- α) which affect insulin like growth factor-1 (IGF-1) formation.¹⁴ Interestingly, increased IGF-1 levels have been shown to stimulate linear growth. And there is more. In the etiology of stunting, aflatoxin contamination of food has also been suggested as following a mechanism similar to EE.¹⁴

Thus, a better understanding of the gut microbiome may help to design improved nutrition interventions. A twin study

from Malawi published earlier this year in *Science*¹⁵ points to this fact. The composition of the microbiota of children with kwashiorkor treated with ready-to-use therapeutic food (RUTF) became “healthier” with increases of bifidobacteria and lactobacilli. The transplantation of the gut microbiota from children with kwashiorkor into the gut of mice caused the mice to lose weight when on a carbohydrate-based diet, but this did not occur with the RUTF. Furthermore, we should also remember that iron supplementation changes the gut microbiota, increasing pathogenic and reducing beneficial bacteria (bifidobacteria and lactobacilli), with attendant increased inflammation.¹⁶ It is complex indeed.

“Nutrition interventions need to be implemented in tandem with interventions from other sectors”

The message is that nutrition interventions need to be integrated and implemented in tandem with interventions from other sectors if we are to achieve maximal benefit, and the benefits have to be measured and scrutinized. Thus, a major task for the nutrition field remains to ensure cross-sectoral approaches – understanding the interplay between health, agriculture, water and sanitation, social protection, and education as key elements – and to break down the silos. This will require innovative systems for implementation research, which undoubtedly is the way forward for ensuring good growth and development for all.

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References

01. World Bank Group Scales up Support for Global Nutrition Programs in Response to Stunting Crisis, Food Price Volatility, 6 June 2013. Internet: www.worldbank.org/en/news/press-release/2013/06/06/world-bank-group-scales-up-support-for-global-nutrition-programs-in-response-to-stunting-crisis-food-price-volatility.
02. Paper 1: Black RE, Victora CG, Walker SP et al. Maternal and child undernutrition and overweight in low-income and middle-income countries. Paper 2: Bhutta ZA, Das JK, Rizvi A et al. Evidence-based interventions for improvement of maternal and child nutrition: what can be done and at what cost? Paper 3: Ruel MT, Alderman H, and the Maternal and Child Nutrition Study Group. Nutrition-sensitive interventions and programs: how can they help to accelerate progress in improving maternal and child nutrition? Paper 4: Gillespie S, Haddad L, Mannar V et al. The politics of reducing malnutrition: building commitment and accelerating progress. *The Lancet*. June 6, 2013. Internet: www.thelancet.com/series/maternal-and-child-nutrition.
03. World Health Assembly resolutions and documents related to nutrition. WHA65/6 Maternal, infant and young child nutrition, 21–26 May 2012. Internet: www.who.int/nutrition/topics/wha_nutrition/en/index.html.
04. Andris Piebalgs European Commissioner for Development Intervention at the Global Hunger Event London, 12 August 2012. Internet: www.europa.eu/rapid/press-release_SPEECH-12-575_en.htm.
05. Nutrition for Growth: Beating Hunger Through Business and Science, 8 June 2013. Internet: www.gov.uk/government/news/nutrition-for-growth-beating-hunger-through-business-and-science.
06. Improving Child Nutrition: The Achievable Imperative for Global Progress. Unicef publication. Internet: www.unicef.org/publications/index_68661.html.
07. A New Global Partnership: Eradicate Poverty and Transform Economies Through Sustainable Development. The High Level Panel on the Post-2015 Development Agenda. Internet: www.post2015hlp.org/the-report/.
08. Muthayya S, Rah JH, Sugimoto JD et al. The global hidden hunger indices and maps: an advocacy tool for action. *PLoS One*. 2013 Jun 12;8(6):e67860. doi: 10.1371/journal.pone.0067860.
09. The Fome Zero (Zero Hunger) program. The Brazilian experience. da Silva JE, del Grossi ME, de França CG (eds). FAO publication. Internet: www.fao.org/docrep/016/ap339e/ap339e.pdf.
10. Growth and Sanitation: What Can We Learn from Chickens? Internet: www.unicef.org/sowc98/panel5.htm.
11. Checkley W, Buckley G, Gilman RH et al. Multi-country analysis of the effects of diarrhea on childhood stunting. *Int J Epidemiol*. 2008 Aug;37(4):816–30. doi: 10.1093/ije/dyn099.
12. Semba RD, Kraemer K, Sun K et al. Relationship of the presence of a household improved latrine with diarrhea and under-five child mortality in Indonesia. *Am J Trop Med Hyg* 2011;84(3):443–450.
13. Smith LE, Stoltzfus RJ, Prendergast A. Food chain mycotoxin exposure, gut health, and impaired growth: a conceptual framework. *Adv Nutr*. 2012 Jul 1;3(4):526–31. doi: 10.3945/an.112.002188.
14. The 1st International Conference on Nutrition and Growth (N&G) March 1–3, 2012 – Paris, France, pp 58–62. *Sight and Life Magazine* 26(3);2012, 58–62.
15. Smith MI, Yatsunenko T, Manary MJ et al. Gut microbiomes of Malawian twin pairs discordant for kwashiorkor. *Science*. 2013 Feb 1;339(6119):548–54. doi: 10.1126/science.1229000.
16. Zimmermann MB, Chassard C, Rohner et al. The effects of iron fortification on the gut microbiota in African children: a randomized controlled trial in Cote d'Ivoire. *Am J Clin Nutr*. 2010 Dec;92(6):1406–15. doi: 10.3945/ajcn.110.004564.

- › Reduce extreme poverty – increase prosperity via transfer programs that support equity
.....
- › Ensure adequate nutrition for mothers and children during the first 1,000 days
.....
- › Improve water and sanitation
.....
- › Implement behavior change communication to improve personal hygiene and caring practices; and
.....
- › Empower and educate women

Priorities in the reduction of stunting

1,000 days

It is generally accepted that the 1,000 days from conception to when a child turns two is the greatest window of opportunity for improving health and development. Nutrition interventions during this period have the most significant and sustained impact on the reduction of stunting and are the smartest investment in a child’s future – and the future of that child’s country, too.

Prevention of Stunting in Latin America



Maternal health and nutrition

- > **20%** of all stunting is the result of poor growth in the womb
- > Interventions to improve maternal nutritional status need to target pre-conception

12% of infants are born small for gestational age



Infant and young child feeding

- > Exclusive breastfeeding until six months is the best start for an infant
- > After six months of age children who receive continued breastfeeding to at least two years of age together with safe and appropriate complementary food grow significantly taller than those with the infrequent unvaried diets.

42% of breastfed children aged 6–23 months receive a minimal acceptable diet.¹

Only 36% of infants are exclusively breastfed until six months of age



Water sanitation and hygiene (WASH)

- > Increasing access to improved water, sanitation, and healthcare facilities is essential for disease prevention and treatment
- > Children with access to improved WASH facilities have greater height gains compared with children who have no access

89% of people use improved drinking water sources and **74%** use improved sanitation facilities

47% of children under five years with diarrhea received oral rehydration and continued feeding

Optimal health, growth, and development

- > A non-stunted child has the best opportunity to achieve their optimal physical and mental capacity, increasing their ability to learn and their future earning capacity.
- > A non-stunted woman is more likely to give birth to an infant with a healthy birth weight, who is in turn less likely to be stunted, helping to break the intergenerational cycle of malnutrition.²

47% of children in the region are stunted. The lowest prevalence is **6% in Costa Rica**, the highest **48% in Guatemala**



Formative Research at the Forefront

Understanding Context and Behavior to Design Culturally Appropriate Nutrition Interventions

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Key messages

- > If nutrition interventions require participants to change their behavior, then program planners must understand the socio-cultural context of the health-seeking behavior in question.
- > Formative research that examines behavior from the perspective of the participant, as opposed to the perspective of the practitioner, will better help inform intervention planning, design, implementation, and monitoring.
- > Rapid assessment procedures, focused ethnographic studies, and knowledge frameworks are approaches to data collection that can be used to understand the context and determinants of nutrition-related behavior in order to create culturally appropriate interventions.
- > Without well-planned and thorough formative research, interventions may not have the potential to make a positive impact on the relevant target population.

Behavior change and public health

Behavior change is at the core of most public health interventions. Whether it is changing the behavior of beneficiaries within a program, or gaining buy-in or commitment from key stakeholders such as community leaders, program staff, and policy-makers,

practitioners must rely on others' behavior change for nutrition interventions to be successful. Changing the behaviors of people is challenging because they are often deeply embedded in cultural (or organizational) practices and patterns of exchange that are shaped by environmental, political, and social factors. In public health, behavior-change interventions are those programs that we design specifically in to change old behaviors or promote new health-seeking behaviors that will create a positive impact on a health outcome. For some nutrition interventions, we only try to impact upon a single behavior (e.g., bringing a child to a health center and taking a pill for de-worming). In other cases, where multiple behaviors give rise to a set of practices, the list of behaviors to change can be extensive (e.g., complementary feeding practices, management of childhood illnesses, improved hygiene and sanitation). Yet despite the centrality and magnitude of behaviors to public health interventions, nutritionists give very little importance to understanding behavior, how it arises, what drives it, and what attitudes and beliefs underlie it. Too often, we see money, time, and capacity of health personnel invested in interventions that were not designed with a complete understanding of the many determinants of the behavior of interest. These interventions are likely to face challenges with coverage (how well the target population can be reached), adherence (how well participants engage in the target behavior), and sustainability (how long participants will engage in the target behavior).

“Nutritionists give very little importance to understanding behavior, how it arises, what drives it, and what attitudes and beliefs underlie it”

To better understand the beliefs, attitudes, and intentions underlying behaviors, as well as the limiting or facilitating

Definitions

.....
Formative research: a type of mixed methods research used to gather information on the beliefs and behaviors of a population in order to develop an intervention or program.

.....
Ethnography: a tradition of qualitative research used by anthropologists to study culture – that is, to build a systematic understanding of the meaning of behavior.

.....
FES (focused ethnographic study): a community-based study that uses multiple methods of applied ethnography to describe and understand the context of health behaviors. Sometimes referred to as RAP (rapid assessment procedures).

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Knowledge frameworks: a conceptual framework that shows the interrelationships among the cognitive elements that underlie participant behaviors.

factors for engaging in a desired behavior, program planners can use formative research – a type of research that gathers information on the beliefs and behaviors of a population, similar to how market research is conducted in order to capture consumer behaviors and preferences in commercial business. We advocate for formative research that is conducted from the point of view of the people being studied, or what is referred to as an *emic* or insider perspective. Formative research has its origins in ethnography, where a set of methodological tools are used to explain the social processes and cultural representations of health and illness in a community. Ethnography can often be time-intensive, so in the past 20 years, public health practitioners have adapted the anthropological tools to collect sociocultural and contextual information in less time. Examples of these tools are focused ethnographic study (FES) and rapid assessment procedures (RAP). Such methodological approaches have allowed for the integration of emic perspectives in designing culturally appropriate, not merely culturally acceptable, interventions.¹ Since the first FES was developed for the World Health Organization in 1992 for the control of acute respiratory illnesses in children by Pelto and Gove, FES and RAP toolkits have been developed to enhance the likelihood for successful interventions and thus impact upon nutritional status of vulnerable target groups.² The toolkits may include in-depth interviews, direct observations, community workshops, focus group discussions (FGD), free lists, and pile sorts. Depending on the goals and resources of the nutrition program, different methods can be used as part of FES or RAP. Formative research elucidates barriers and facilitating factors to a desired behavior, highlights the best delivery channel(s) for

promoting that behavior, and reveals key factors and people who are likely to influence, promote, and limit the target behavior. This information can then be used to design culturally appropriate interventions, grounded in the point of view of the participant that address the potential barriers in addition to leveraging the facilitators to enhance behavior change.

Formative research at the forefront of micronutrient programs

With the recent advent of micronutrient powders (MNP) and lipid-based nutrient supplements (LNS) for children of 6–23 months and pregnant and lactating women, there has been a strong movement towards using formative research because the success of these interventions depends on caregivers engaging in two important behaviors: **1)** accepting the novel product, and **2)** using it appropriately (i.e., providing it only to the intended beneficiary on a consistent basis, mixing it with complementary foods, or providing it directly out of a sachet in the case of LNS). Formative research conducted in Africa for MNP and LNS has relied on a combination of FGD and home feeding studies to assess the acceptability, home utilization, and appropriate promotion of such products. In western Kenya in 2010, Jefferds and colleagues used 14 FGD and a four-week home feeding study prior to developing an MNP program.³ For distribution of MNP and LNS using a market-based approach in Niger, Tripp and colleagues conducted 84 FGD, 80 key informant interviews, and a four-week home feeding study with the food products.⁴ More recently, a team of researchers used a FES to determine the appropriateness of specialized food commodity programs in three different country contexts: Ghana, South Africa, and Afghanistan.⁵ In Nepal, researchers used structured questionnaires, 24-hour dietary recalls, interviews, and FGD among caretakers of young children to identify the many and various barriers that discourage optimal nutrition practices in order to develop culturally appropriate strategies to improve feeding practices.⁶

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“Too often, interventions are planned and executed without any insight or voice from the target audience”

Although the international nutrition field is recognizing the need for formative research, it is still not uncommon for donors and governments to overlook the value of disbursing extra funds and additional program time for thorough formative research. Too often, interventions are planned and executed without any insight or voice from the target audience. Formative research has been conspicuously missing from nutrition intervention efforts,⁴ despite evidence that interventions using well-planned

Ethnographic methods and complementary feeding programs

For a good introduction on ethnographic methods, read Book 3 of the Ethnographer's Tool Kit [Schensul S. Essential Ethnographic Methods: Observations, Interviews, and Questionnaires. Oxford: Atamira Press, 1999]. If you are thinking about complementary feeding programs, see specifically designed formative research tools: ProPAN, Process for the Promotion of Child Feeding from Pan American Health Organization (available free online. Training is needed to use Pro-PAN); TIPs, Trials for Improved Practices by the Manoff Group.

formative research have resulted in improved breastfeeding practices in sub-Saharan Africa,⁷ complementary feeding in Peru⁸ and Mexico,⁹ the use of insecticide-treated bed nets in Tanzania,¹⁰ better hygiene practices in Kyrgyzstan,¹¹ and the use of condoms to reduce HIV prevalence among young men in Thailand.¹² Similar to assessment of nutritional status, formative research requires careful planning, execution, and time – that is, formative research has to be done well to design culturally appropriate interventions.

We have at least one clear example of what can happen when formative research is done superficially. This learning experience comes from an MNP program that was conducted at Kakuma Refugee Camp, Kenya. In 2009, as part of the World Food Programme–DSM partnership, *Improving Nutrition – Improving Lives*, and in collaboration with the United Nations High Commissioner for Refugees, a large-scale MNP program was implemented among the entire 50,000-person refugee camp population. The program had a limited impact on nutritional status.¹³ The program monitoring data showed that only 30%–52% of the camp population was picking up the free MNP from the distribution points and staff did not know if and how the product was being used by the beneficiaries. After a comprehensive qualitative assessment to understand why the program did not have the desired impact, Kodish and colleagues concluded that the beneficiaries neither received culturally appropriate information about the new product nor were they exposed to adequate and appropriate promotion of the MNP.¹⁴ The MNP packaging had an unfamiliar cartoon logo on it that, for many people, represented an evil genie or ghost. Also, the MNP sachet was similar to a condom package and rumors were generated throughout the camp that it was a birth control product meant to limit the camp population. The researchers ascribed much of the problem to an informal, two-week formative research phase that did not fully consider the complexity of the situation at the camp: eight different ethnic groups with several religious affiliations and numerous languages, implementing agencies

that were not fully aligned on key aspects of the project, and a limited budget allocation for such an expansive, camp-wide intervention.

Current application in the field

As the international community places greater emphasis on preventative nutrition programs utilizing MNP and LNS, additional capacity, resources, and guidance have been required for effective roll-out and scale-up. In support of government efforts to address chronic malnutrition the World Food Programme has been collaborating with the Johns Hopkins Bloomberg School of Public Health on several multi-stage, formative research projects in both Malawi and Mozambique applying RAP methodology specifically designed for specialized food commodity programs. In these settings, RAP will describe the patterns and determinants of intra- and interhousehold food allocation, as well as the enabling factors and potential barriers to appropriate complementary feeding practices. These findings will in turn be used to develop culturally appropriate messaging, packaging, and communications strategies based on local concepts and behavior to promote age-appropriate, energy-dense foods, including a small-quantity LNS. Depending on the scope and setting of a proposed nutrition program, thorough formative research using RAP may be conducted in just 6 to 12 weeks. However, this timeline depends on many factors including, but not limited to, the number of languages, ethnic groups, and stakeholders involved.

A RAP or FES approach is not the lone strategy to understand participant behavior. Knowledge frameworks are another useful approach, allowing program planners to identify caregivers' knowledge, attitudes, and beliefs, as well as examine how these cognitive elements are interrelated and linked to social and structural factors.¹⁵ This approach generally requires 20–40 in-depth interviews with caregivers and home observations. The qualitative data are extracted to then define the main cognitive elements around feeding children. For example, in one recent nutrition study in Mexico, the knowledge framework consisted of eight elements that explained when complementary feeding began, what types of foods were considered child-appropriate, and the social and economic factors that influenced what foods the child received.¹⁵ This knowledge framework was then used to design the essential structure of a complementary feeding intervention.⁹ When knowledge frameworks are used for program planning, formative research can then be used to pre-test elements of an intervention, such as messages and posters (colors, logos, images), as well as to facilitate discussion around key factors that would affect actual program delivery. In the aforementioned example in Mexico that used this type of approach, the field work, data analysis, and report writing with final inputs were completed in six months. The time required for this approach will vary by setting.



Brainstorming barriers to program implementation in a community workshop

Formative research is not only limited to the program planning or design phase, but also can extend to the actual intervention or program itself. Data gathered during a formative phase can be useful for monitoring key program activities, and then help to evaluate how elements of the program are actually being delivered (or not delivered) – the fidelity of a program.¹⁶ This research that happens when the program is ongoing is oftentimes referred to by researchers as process evaluation or by practitioners as program monitoring. The qualitative and quantitative data derived from these efforts can help guide and improve a program if things are not going as planned.

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“Donors should demand that well-planned formative research be conducted and used for implementing an intervention”

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Conclusion

In summary, formative research uses a variety of qualitative and quantitative methods to understand behavior and the context surrounding it. The duration of the formative research phase and the type of methods used will depend on (a) the type of behavior; (b) what is already known (or unknown) about what drives the behavior; (c) the complexity of the intervention (promoting a single behavior, changing multiple behaviors, or using integrated approaches); and (d) the social and cultural context. It is unlikely that there is a one-size-fits-all approach.

In public health nutrition, an indicator by which one can assess the effectiveness of formative research is to what extent behavior change was achieved and sustained throughout an intervention. Of course, this does not mean that if behavior change was not achieved or sustained that formative research was not done well, as there could be many causes of a failed intervention unrelated to the formative work. For some interventions (e.g., MNP), the program success can be assessed through program coverage and adherence indicators. For others, it will be important to also consider exposure to message and message recall, or perhaps an observational study to confirm that the behaviors are

being carried out as intended. Evidence of formative research being used to help plan nutrition interventions is building as researchers are acknowledging that it is an essential step in intervention planning and design. Donors should demand that well-planned formative research be conducted and used for implementing an intervention.

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References

01. Scrimshaw SCM, Hurtado E. Rapid Assessment Procedures for nutrition and primary health care: Anthropological Approaches to Improving Programme Effectiveness. Tokyo: UNU Press, 1987.
02. Pelto GH, Gove S. Developing a focused ethnographic study for the WHO acute respiratory control programme. In: Rapid Assessment Procedures: Qualitative Methodologies for Planning and Evaluations of Health Related Programmes (Scrimshaw NS, Gleason GR eds). Boston, MA: International Nutrition Foundation, 1992:215–226.
03. Jefferds MED, Ogame L, Owuor M et al. Formative research exploring acceptability, utilization, and promotion in order to develop a micronutrient powder (Sprinkles) intervention among Luo families in western Kenya. *Food & Nutrition Bulletin* 2010; 31 (Supp. 2): S179–85.
04. Tripp K, Perrine CG, de Campos P et al. Formative research for the development of a market-based home fortification programme for young children in Niger. *Matern Child Nutr* 2011; 7 (Supp. 3):S82–95.
05. Pelto GH, Armar-Klemesu M, Siekmann J et al. The focus ethnographic study 'assessing the behavioral and local market environment for improving the diets of infants and young children 6–23 months old' and its use in three countries. *Matern Child Nutr* 2013; S9:35–46.
06. Locks LM, Pandey PR, Osei AK et al. Using formative research to design a context-specific behavior change strategy to improve infant and young child feeding practices and nutrition in Nepal. *Matern Child Nutr* 2013. Available online at <http://onlinelibrary.wiley.com/doi/10.1111/mcn.12032/abstract>.
07. Quinn VJ, Guyon AB, Schubert JW et al. Improving breastfeeding practices on a broad scale at the community level: success stories from Africa and Latin America. *J Hum Lact* 2005;21:345–54.
08. Penny ME, Creed-Kanashiro, HM, Robert, RC et al. Effectiveness of an educational intervention delivered through the health services to improve nutrition in young children: a cluster-randomised controlled trial. *Lancet* 2005;365:1862–72.
09. Monterrosa EC, Frongillo EA, Gonzalez-Cossio T et al. Targeted messages delivered by nurses and radio changed beliefs, attitudes and behaviors for infant and young child feeding in Mexico. *J Nutr* 2013;143:915–22.
10. Minja H, Schellenberg JA, Mukasa O et al. Introducing insecticide-treated nets in the Kilombero Valley, Tanzania: the relevance of local knowledge and practice for an information, education, and communication (IEC) campaign. *Trop Med Int Health* 2001;6:614–23.
11. Biran A, Tabyshaliev A, Salmorbekova Z. Formative research for hygiene promotion in Kyrgyzstan. *Healthy Policy Plan* 2005; 20:213–21.
12. Nelson KE, Celetano DD, Eiumtrakol S et al. Changes in sexual behaviors and a decline in HIV infection among young men in Thailand. *N Engl J Med* 1996;335:297–303.
13. Rah JH, de Pee S, Kraemer K et al. Program experience with micronutrient powders and current evidence. *J Nutr* 2012;142:191–6S.
14. Kodish S, Rah JH, Kraemer K et al. Understanding low usage of micronutrient powder in the Kakuma Refugee Camp, Kenya: Findings from a qualitative study. *Food Nutr Bull* 2011;32(3): 292–303.
15. Monterrosa EC, Pelto GH, Frongillo EA et al. Constructing maternal knowledge frameworks. How mothers conceptualize complementary feeding. *Appetite* 2012;59:377–84.
16. Gittlesohn J, Suratkar S, Song H et al. Process evaluation of Baltimore Healthy Stores: A pilot health intervention program with supermarkets and corner stores in Baltimore City. *Health Promot Pract* 2010;11:723–32.

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Vitamin D Across the Life Cycle with Special Emphasis on Latin America

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Key messages

- > Vitamin D deficiency is a worldwide public health problem that affects people of all ages from neonates to the elderly.
- > Vitamin D is important for calcium homeostasis and the development and maintenance of the skeleton. It plays an essential role in every stage of the life cycle and has the potential to influence a wide range of health outcomes given that nearly every cell in the body has a vitamin D receptor.
- > There is a lack of consensus regarding vitamin D supplementation during pregnancy.
- > Vitamin D deficiency during pregnancy has been reported to be associated with a number of poor pregnancy outcomes that include intrauterine growth retardation, premature labor, pre-eclampsia, low birth weight and cesarean section.

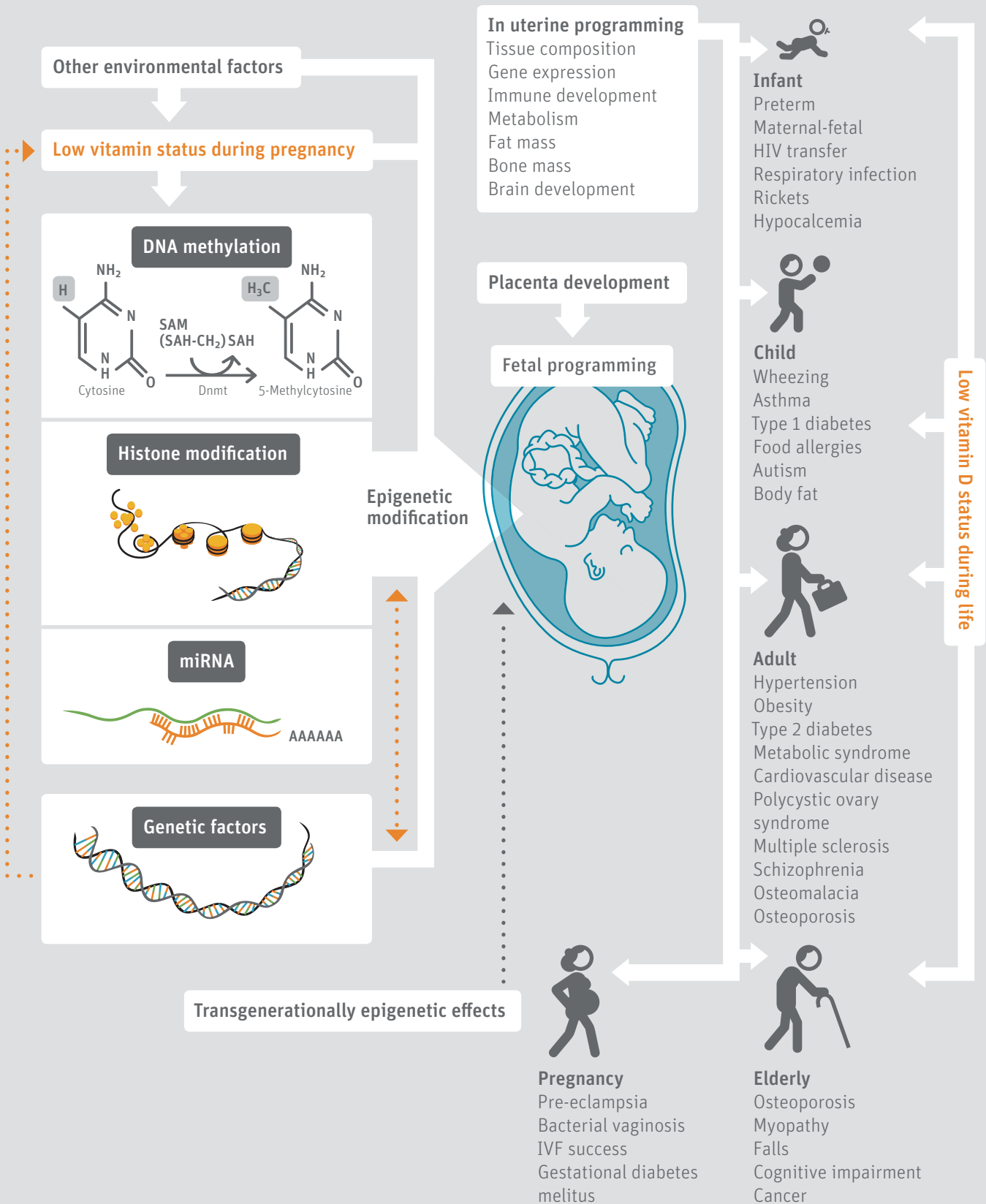
- > Exclusive breastfeeding without vitamin D supplementation or exposure to sunlight are the greatest risk factors for vitamin D deficiency in this age group.
- > A call to action for additional studies, especially nationally representative data, to better understand the vitamin D status in Latin America would be helpful.

Vitamin D deficiency is a worldwide public health problem that affects people of all ages from neonates to the elderly. Global reports show that vitamin D deficiency is present in almost every region of the world,¹⁻⁵ although data on vitamin D status in Latin America are scarce.^{2,4}

Vitamin D is important for calcium homeostasis and the development and maintenance of the skeleton.⁵ It plays an essential role in every stage of the life cycle and has the potential to influence a wide range of health outcomes given that nearly every cell in the body has a vitamin D receptor.⁶ The extraskeletal benefits that vitamin D possesses have received much attention recently, especially since the effect differs across the life cycle (Figure 1).⁶ Effects of vitamin D deficiency encompass increased risk of several cancers (breast, colon, and prostate), hypertension, autoimmune disease (multiple sclerosis, type 1 diabetes, neurocognitive dysfunction), and cardiovascular diseases.⁶ There are approximately 2,000 genes that are regulated by the active metabolite of vitamin D, 1,25-dihydroxyvitamin D (1,25(OH)₂D).^{6,7} These genes are known to inhibit cellular proliferation, stimulate both insulin production and the innate immune system, and play a role in the renin-angiotensin feedback loop.

“Vitamin D plays an essential role in every stage of the life cycle. Nearly every cell in the body has a vitamin D receptor”

FIGURE 1: Vitamin D, placenta development, fetal programming, and epigenetic modification.



Vitamin D comes in two major forms, vitamin D₂ (ergocalciferol) and vitamin D₃ (cholecalciferol). The major form made by plants and mushrooms is vitamin D₂ while cutaneous synthesis produces vitamin D₃. There are two main sources of this micro-nutrient: cutaneous synthesis and dietary sources. Cutaneous synthesis varies by such factors as season, time of day, latitude, altitude, sunscreen use, and skin pigmentation.^{5,6} A single whole body minimal erythemal dose of sunlight (defined as a slight pinkness to the skin 24 hours after sun exposure) will raise the circulating levels of vitamin D₃ to a similar level as if one were to ingest 10,000–25,000 IU of vitamin D.^{5,8} Vitamin D is converted to 25-hydroxyvitamin D (25(OH)D) in the liver, the major circulating form, which is then hydroxylated by the kidneys to 1,25(OH)₂D. 25(OH)D is considered the best biochemical indicator of vitamin D status. Dietary sources of vitamin D include oily fish (such as salmon), sundried mushrooms, and foods fortified with vitamin D, such as milk, orange juice, margarine, and cereals.⁵

There has been debate about what constitutes deficiency. The Institute of Medicine (IOM) currently defines vitamin D deficiency as 25(OH)D levels below 20 ng/mL (50 nmol/L).⁹ The Endocrine Practice Guidelines concurred with this definition and defined vitamin D insufficiency as 21–29 ng/mL (51–74.5 nmol/L), which takes into account both musculoskeletal and extraskeletal benefits.¹⁰ The recommended daily allowance (RDA) for infants is 400 IU/day, for children and adults (up to 70 years) 600 IU/day and for the elderly (> 70 years) 800 IU/day.⁹ Regression models show that for every 100 IU of vitamin D ingested, the serum levels of 25(OH)D increase by 0.6–1 ng/mL.⁶

Pregnancy and lactation

Recent studies from around the world demonstrate a high prevalence of vitamin D deficiency among neonates and their mothers.^{11,12} A study in 40 mother–infant pairs that documented an average intake of 600 IU during pregnancy reported that 76% of mothers and 80% of infants at birth were vitamin D-deficient with a 25(OH)D of <20 ng/mL.¹³ Despite these findings, there is a lack of consensus regarding vitamin D supplementation during pregnancy. In the United States, the current RDA for pregnant and lactating women is 600 IU/day, which is the same as for all adults aged 18–70 years.⁹ The apparent disconnect between the recommendations and the increased maternal requirements for vitamin D has been a point of debate amongst the scientific community.^{10,14}

Vitamin D deficiency during pregnancy has been reported to be associated with a number of poor pregnancy outcomes,¹⁵ which include intrauterine growth retardation, premature labor, pre-eclampsia,¹⁶ low birth weight, and cesarean section.⁶ Studies with mother–infant dyads have shown that maternal vitamin D stores will carry through to the fetus (in a positive correlation between the serum 25(OH)D levels in infants and

mothers).^{13,17} Epidemiologic evidence suggests that fetal programming and the milieu in which a fetus develops can have an effect on the susceptibility to disease later in life.⁶ This is thought to occur through epigenetic modification, which changes gene expression, and has an influence on changing heritable traits and fetal imprinting (Figure 1).⁶

Infants and children

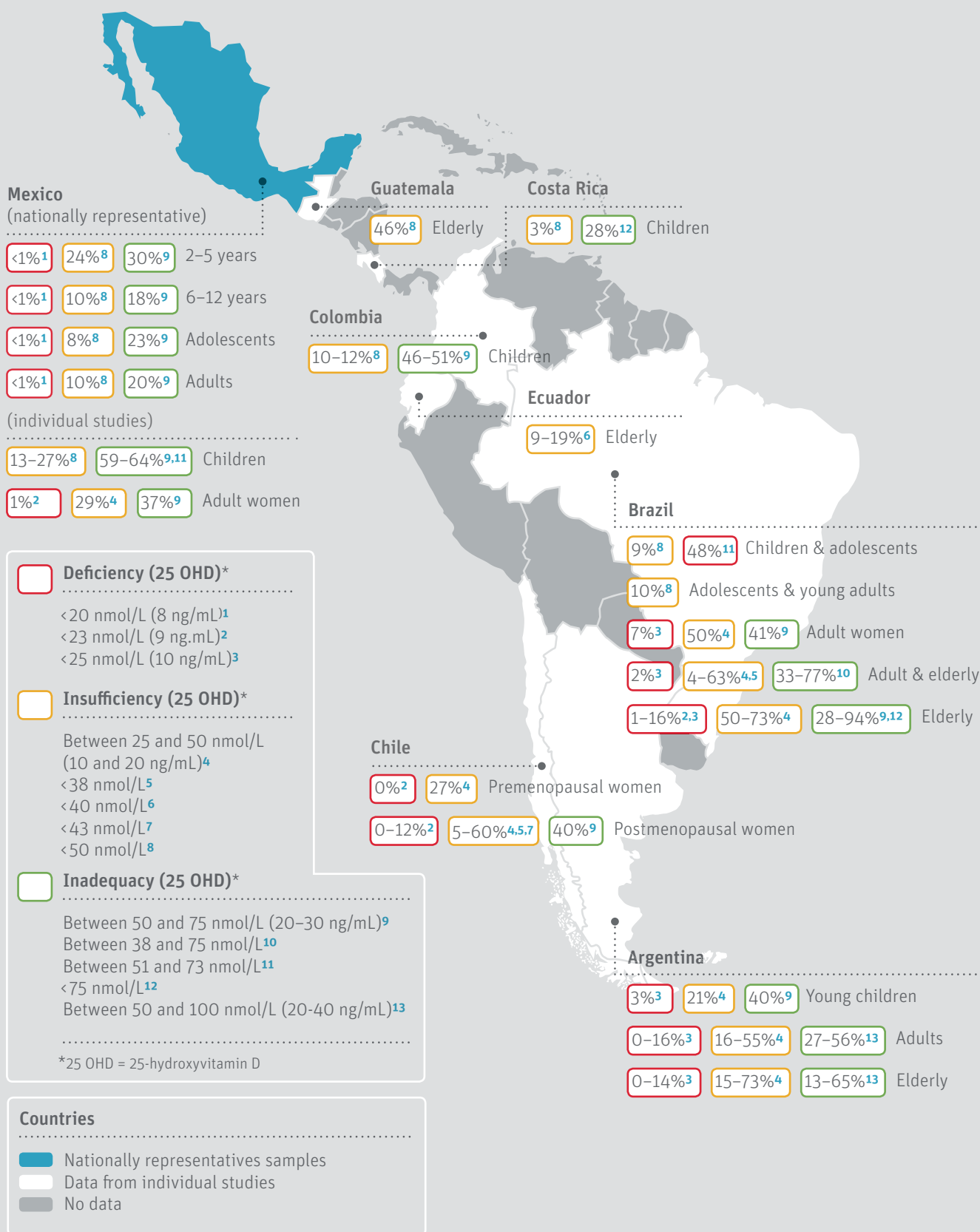
Worldwide studies have demonstrated a high rate of vitamin D deficiency in infants with an alarming incidence of rickets. Exclusive breastfeeding without vitamin D supplementation or exposure to sunlight are the greatest risk factor for vitamin D deficiency in this age group.^{13,15} In one study, infants that were not supplemented were 19 times more likely to be deficient than those infants receiving appropriate supplementation.¹⁸ At present, managing vitamin D status in infants is by directly supplementing infants.¹⁰ A dose of 400 IU/day has been shown to raise serum 25(OH)D levels above 20 ng/mL.¹⁴ However, high-risk populations, such as premature infants, those with darker skin pigmentation, people living in northern latitudes, and groups living through the winter months may require greater intake to achieve sufficiency.¹⁰ Another option is to expose infants to sunlight and dietary diversification. Specker et al. have reported that a diapered infant exposed to 30 min/wk of sunlight in the Midwestern United States is protected from vitamin D deficiency.¹⁹ This may not be a very popular method due to cultural beliefs as well as recommendations from medical authorities. For instance, the American Academy of Pediatrics recommends that infants of less than six months should not be exposed to sunlight at all to prevent skin cancer.²⁰

Severe deficiency (25(OH)D <10 ng/mL) in young children results in poor mineralization of the growing skeleton leading to rickets.^{5,21,22} Mounting epidemiological evidence shows that vitamin D deficiency during infancy is associated with autoimmune disease later in life, including type 1 diabetes mellitus,²³ multiple sclerosis,²⁴ and Crohn's disease.²⁵

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 “Mounting epidemiological evidence shows that vitamin D deficiency during infancy is associated with autoimmune disease later in life”

More recently, much attention has been drawn to the association between vitamin D and infectious diseases such as tuberculosis, pneumonia, and upper and lower respiratory tract infections. Vitamin D is capable of modulating the activity of lymphocytes, neutrophils, macrophages, and respiratory epithe-

FIGURE 2: Vitamin D status in Latin America and the Caribbean.



Reproduced with Permission. Brito A, Cori H, Olivares M, et al. Less than adequate vitamin D status and intake in Latin America and the Caribbean: A problem of unknown magnitude. *Food & Nutrition Bulletin* 34.1 (2013): 52-64



Parents in Ecuador have the propensity to cover up their infants, as is clearly demonstrated by this snapshot.

lial cells,²⁶ and increases the expression of genes encoding for antimicrobial peptides, cathelicidin, and β -defensin and hence the innate immune response.

Adolescents

Adolescents deserve a special mention since it is a crucial time for bone development and growth. This is the time when the most rapid growth in bone occurs. In fact, Molgaard et al. have shown that the median calcium accretion rate was 220 mg/day in girls and 317 mg/day in boys.²⁷ Particular attention to vitamin D deficiency is important because it has been linked to increased blood pressure, increased blood sugar levels, and metabolic syndrome.²⁸

Adults

Vitamin D deficiency can cause the painful bone disease osteomalacia and proximal muscle weakness in adults.^{5,6} Insufficiency also causes secondary hyperparathyroidism and increased bone turnover. In addition, there is a multitude of clinical studies in adults linking vitamin D insufficiency with chronic diseases such as cardiovascular disease²⁹ and certain cancers.^{5,6} These include stroke,³⁰ hypertension,³¹ coronary heart disease,³² heart failure, type 2 diabetes, and colon and breast cancer.^{5,6}

Elderly

The elderly are at a particularly high risk for vitamin D deficiency. There is a two- to threefold fold decrease in the cutaneous vita-

min D synthesis after exposure to UVB radiation amongst the elderly. This is due to a reduced amount of the precursor 7-dehydrocholesterol^{5,6} Also, outdoor activity and solar exposure are often limited due to lifestyle changes and mobility. Vitamin D deficiency in the elderly causes osteomalacia and osteoporosis, which increase skeletal fragility.³³ Studies have shown that vitamin D deficiency predisposes the elderly to the risk of fractures accompanied by increased morbidity and mortality associated with hip fractures.^{33,34} This age group is particularly important as the mean life expectancy in Latin America is 74 years of age and a growth in the elderly population is anticipated.⁴

Vitamin D status in Latin America

Most vitamin D studies have focused on North America, Europe, and Oceania. There are scientific studies assessing the prevalence of vitamin D deficiency in Argentina,^{35–37} Brazil,^{38–42} Chile,^{43,44} Colombia,⁴⁵ Ecuador,⁴⁶ Guatemala,⁴⁷ and Mexico.^{48,49} Most of these studies assessed the association between vitamin D deficiency and bone mineral health in children, adolescents, adults, postmenopausal women, and the elderly. The number of publications is lower than in many regions of the world and so Latin America is one area where the prevalence of vitamin D status is not well established. Yet, South America is a diverse continent, both culturally, as well as with regards to latitudes that span 12° N to 55° S.⁴

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 “Latin America is one area
 where the prevalence
 of vitamin D status is not
 well established”

A considerable prevalence of vitamin D insufficiency and deficiency in different age groups was reported despite environmental factors that favor vitamin D production. The first studies to emerge from Latin America were from Argentina, which showed clearly seasonal variations that have been reported in the northern hemisphere.⁴ A study amongst children in the southernmost city in the world (55° S), in Ushuaia, Argentina, showed that this seasonal trend was present.³⁵ Elderly Mayans living at higher altitudes in Guatemala have shown that deficiency is also present in an environment considered to be protective against vitamin D deficiency.⁴⁷ In Brazil, Unger et al. performed the largest epidemiological study of vitamin D in South America.³⁸ In São Paulo, 603 healthy subjects aged 18–90 years were prospectively followed to determine their 25(OH)D levels. After the winter months, 77.4% of subjects had a serum 25(OH)D <30 ng/mL while after the summer, 37.3% had a 25(OH)D

<30ng/mL. Mexico has the only nationally representative data in Latin America showing considerable vitamin D insufficiency as shown in **Figure 2**.^{48,50} In addition, studies in Brazil, Costa Rica, and Ecuador report dietary intake of vitamin D that is lower than the current recommendations. **Figure 2** shows the prevalence of vitamin D deficiency, insufficiency, and inadequacy in Latin America and the Caribbean in different age groups.⁵⁰ Most studies report a considerable prevalence of vitamin D insufficiency and deficiency in different age groups. However, it is necessary to remain cautious with preliminary conclusions from these figures, since a need for additional studies and data at the national level within each country would provide a better assessment.

Conclusions

Vitamin D plays an important role for health in every stage of the life cycle. There has been much focus on the extraskeletal health benefits of vitamin D. Further studies are required to establish whether the recommended daily allowance fulfills the requirements or if there is an optimal daily dose for vitamin D at every stage of the life cycle and for recommendations for sensible sun exposure.⁶ Also, a call to action for additional studies, especially nationally representative data, to better understand the vitamin D status in Latin America would be helpful.

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References

- Lips P. Worldwide status of vitamin D nutrition. *J Steroid Biochem Mol Biol* 2010;121:297–300.
- Mithal A, Wahl DA, Bonjour JP et al. IOF Committee of Scientific Advisors (CSA) Nutrition Working Group. Global vitamin D status and determinants of hypovitaminosis D. *Osteoporos Int* 2009; 20(11):1807–20.
- Lips P, van Schoor NM. Worldwide vitamin D status. *Best Pract Res Clin Endocrinol Metab* 2011; 25:671–80.
- González G. Vitamin D status among healthy postmenopausal women in South America. *Dermato-Endocrinology* 2013;5:0 1–4; <http://dx.doi.org/10.4161/derm.24807>
- Holick MF. Vitamin D deficiency. *N Engl J Med* 2007;357(3):266–81.
- Hosseini-nezhad A, Holick MF. Vitamin D for Health: A Global Perspective. *Mayo Clin Proc* 2013;1–36. DOI: 10.1016/j.mayocp.2013.05.011
- Nagpal S, Na S, Rathnachalam R. Noncalcemic actions of vitamin D receptor ligands. *Endocr Rev* 2005;26(5):662–87.
- Holick MF. The D-lightful vitamin D for child health. *J Parenter Enteral Nutr* 2012;36(1, suppl):9S–19S.
- Ross AC, Manson JE, Abrams SA et al. The 2011 report on dietary reference intakes for calcium and vitamin D from the Institute of Medicine: what clinicians need to know. *J Clin Endocrinol Metab* 2011;96(1):53–8.
- Holick MF, Binkley NC, Bischoff-Ferrari HA et al. Endocrine Society: Evaluation, Treatment and Prevention of Vitamin D Deficiency: An Endocrine Society Clinical Practice Guidelines. *J Clin Endocrinol Metab* 2011;96(7):1911–30.
- Diogenes MEL, Bezerra FF, Rezende EP et al. Effect of calcium plus vitamin D supplementation during pregnancy in Brazilian adolescent mothers: a randomized, placebo-controlled trial. *Am J Clin Nutr* 2013;98:82–91.
- Bodnar LM, Simhan HN, Powers RW et al. High prevalence of vitamin D insufficiency in black and white pregnant women residing in the northern United States and their neonates. *J Nutr* 2007;140(5):999–1006.
- Lee JM, Smith JR, Philipp BL et al. Vitamin D deficiency in a healthy group of mothers and newborn infants. *Clin Pediatr (Phila)* 2007;46:42–4.
- Hollis BW, Johns D, Hulsey TC et al. Vitamin D Supplementation during Pregnancy: Double Blind, Randomized Clinical Trial of Safety and Effectiveness. *J Bone Miner Res* 2011;26(10):2341–57.
- Thorne-Lyman A, Fawzi WW. Vitamin D during pregnancy and maternal, neonatal and infant health outcomes: A systemic review and meta-analysis. *Paediatr Perinat Epidemiol* 2012; 26(suppl):75–90.
- Bodnar LM, Catov JM, Simhan HV et al. Maternal vitamin D deficiency increases the risk of pre-eclampsia. *J Clin Endocrinol Metab* 2007;92(9):3517–22.
- Dawodu A, Zalla L, Woo JG et al. Heightened attention to supplementation is needed to improve the vitamin D status of breastfeeding mothers and infants when sunshine exposure is restricted. *Matern Child Nutr* 2012; doi: 10.1111/j.1740-8709.2012.00422.x.
- Merewood A, Mehta SD, Grossman X et al. Vitamin D status among 4-month-old infants in New England: a prospective cohort study. *J Hum Lact* 2012 May;28(2):159–66.
- Specker B, Valanis B, Hertzberg V et al. Sunshine exposure and serum 25-hydroxyvitamin D concentrations in exclusively breastfed infants. *J Pediatr* 1985;107:372–6.
- Balk SJ. Council on Environmental Health; Section on Dermatology. Policy Statement – Ultraviolet radiation: a hazard to children and adolescents. *Pediatrics* 2011;127(3):588–97.
- Holick MF. Resurrection of vitamin D deficiency and rickets. *J Clin Invest* 2006. 1162062–2072.2072.

22. Fitzpatrick S, Shead NF, Clark NG et al. Vitamin D deficient rickets: a multifactorial disease. *Nutr Rev* 2000;58:218–22.
23. Hyppönen E, Läärä E, Reunanen A et al. Intake of vitamin D and risk of type 1 diabetes: a birth-cohort study. *Lancet* 2001;358(9292):1500–3.
24. Willer CJ, Dymant DA, Sadovnick AD et al. Timing of birth and risk of multiple sclerosis: population based study. *BMJ* 2005; 330(7483):120.
25. Bartels LE, Jorgensen SP, Bendix M et al. 25-Hydroxyvitamin D3 modulates dendritic cell phenotype and function in Crohn's disease. *Inflammopharmacology* 2013;21(2):177–186.
26. Liu PT, Stenger S, Li H et al. Toll-like receptor triggering of a vitamin D-mediated human antimicrobial response. *Science* 2006; 311:1770–3.
27. Molgaard C, Thomsen BL, Michaels KF. Whole body bone mineral accretion in healthy children and adolescents. *Arch Dis Child* 1999; 81:10–15.
28. Lamberg-Allardt CJE, Viljakainen HT. 25-Hydroxyvitamin D and functional outcomes in adolescents. *Am J Clin Nutr* 2008; 88(suppl):534S–6S.
29. Kumar J, Muntner P, Kaskel FJ et al. Prevalence and associations of 25-hydroxyvitamin D deficiency in US children:NHANES 2001-2004. *Pediatrics* 2009;124:362–70.
30. Wang TJ, Pencina MJ, Booth SL et al. Vitamin D deficiency and Risk of Cardiovascular Disease. *Circulation* 2008;117:503–11.
31. Forman JP, Giovannucci E, Holmes MD, Bischoff-Ferrari HA, Tworoger SS, Willet WC et al. Plasma 25-hydroxyvitamin D levels and risk of incident hypertension. *Hypertension*. 2007;49:1063–9.
32. Lee JH, Gadi R, Spertus JA et al. Prevalence of vitamin D deficiency in patients with acute myocardial infarction. *Am J Cardiol* 2011; 107:1636–8.
33. Bischoff-Ferrari HA, Willett WC, Orav EJ et al. A pooled analysis of vitamin D dose requirements for fracture prevention. *N Engl J Med* 2012;367(1):40–9.
34. Bischoff-Ferrari HA, Willett WC, Wong JB et al. Prevention of nonvertebral fractures with oral vitamin D and dose dependency: a meta-analysis of randomized controlled trials. *Arch Intern Med* 2009;169(6):551–61.
35. Oliveri MB, Ladizesky M, Mautalen CA et al. Seasonal variations of 25 hydroxyvitamin D and parathyroid hormone in Ushuaia (Argentina), the southernmost city of the world. *Bone Miner* 1993; 20(1):99–108.
36. Oliveri B, Plantalech L, Bagur A et al. High prevalence of vitamin D insufficiency in healthy elderly people living at home in Argentina. *Eur J Clin Nutr* 2004;58:337–42.
37. Duran P, Mangialavori G, Biglieri Am Kogan L et al. Nutrition status in Argentinean children 6 to 72 months old. Results from the National Nutrition and Health Survey (ENNyS). *Arch Argent Pediatr* 2009;107:397–404.
38. Unger M, Cuppari L, Titan S et al. Vitamin D status in a sunny country: where has the sun gone? *Clin Nutr* 2010; 29:784–8.
39. Bandeira F, Griz L, Freese E et al. Vitamin D deficiency and its relationship with bone mineral density among postmenopausal women living in the tropics. *Arq Bras Endocrinol Metabol* 2010; 54:227–32.
40. Lopes J, Danilevicius C, Takayama L et al. Vitamin D insufficiency: a risk factor to vertebral fractures in community-dwelling elderly women. *Maturitas* 2009;64:218–22.
41. Saraiva GL, Cendoroglo MS, Ramos LR et al. Prevalência da deficiência, insuficiência de vitamina D e hiperparatiroidismo secundário em idosos institucionalizados e moradores na comunidade a cidade de São Paulo, Brasil (in Portuguese). (Prevalence of vitamin D deficiency, insufficiency and secondary hyperparathyroidism in the elderly inpatients and living in the community of the city of São Paulo, Brazil). *Arq Bras Endocrinol Metabol* 2007;51:437–42.
42. Maeda SS, Saraiva GL, Hayashi LF et al. 25-hydroxyvitamin D delayed response to seasonal ultraviolet B radiation in São Paulo, Brazil; The São PAULO Vitamin D Evaluation Study (SPADES). *Dermato-Endocrinology* 2013;5(1):1–7.
43. Gonzalez G, Alvarado J, Rojas A et al. High prevalence of vitamin D deficiency in Chilean healthy postmenopausal women with normal sun exposure: additional evidence for a worldwide concern. *Menopause* 2007;14:455–61.
44. Rodríguez J. Vitamin D levels in postmenopausal women with low bone mineral density. *Rev Med Chil* 2001;129:31–6.
45. Gilbert-Diamond D, Baylin A, Mora-Plazas M et al. Vitamin D deficiency and anthropometric indicators of adiposity in school-age children: a prospective study. *Am J Clin Nutr* 2010;92:1446–51.
46. Hamer D, Sempertegui F, Estrella B et al. Micronutrient deficiencies are associated with impaired immune response and higher burden of respiratory infections in elderly Ecuadorians. *J Nutr* 2009; 139:113–9.
47. Sud S, Montenegro-Bethancourt G, Bermúdez O et al. Older Mayan residents of the western highlands of Guatemala lack sufficient levels of vitamin D. *Nutr Res* 2010;30:739–46.
48. Flores M, Barquera S, Sanchez L et al. Concentraciones séricas de vitamina D en niños, adolescentes y adultos mexicanos Resultados de la ENSANUT 2006 (in Spanish). (Serum concentrations of vitamin D in Mexican children, adolescents and adults. Results from the 2006 National Health Survey). Available at: https://siid.insp.mx/www/proyecto_detalle_v3.asp?id=1-591-6358.
49. Elizondo-Montemayor E, Ugalde-Casas P, Serrano-González M et al. Serum 25-hydroxyvitamin D concentration, life factors and obesity in Mexican children. *Obesity* 2010;18:1805–11.
50. Brito A, Cori H, Olivares M et al. Less than adequate vitamin D status and intake in Latin America and the Caribbean: A problem of unknown magnitude. *Food Nutr Bull* 2013;34.1: 52–64.

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Adequate Nutrient Intakes for Infancy

Part 3: Adequate Nutrition for Children 24 to 59 Months

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Key messages

- > In low- and middle-income countries, current Recommended Nutrient Intakes (RNI) for children 1–6 years of age may not be adequate to prevent moderate malnutrition.
- > Stunting is defined as ≤ 2 standard deviations (SD) below the median of height-for-age, based on WHO child growth standards.
- > Apparently healthy stunted children will also be underweight and can be regarded as moderately malnourished.
- > Inadequate sanitation and poor hygiene increase the risk of disease.
- > Disease and particularly diarrhea are strongly associated with stunting.
- > Some nutritional supplements prevent loss of height following diarrhea.
- > Gut enteropathy is common in apparently healthy infants and preschool children (PSC) in low- and middle-income countries.
- > Gut enteropathy may impair nutrient absorption and contribute to poor growth.
- > If stunted children are moderately malnourished and need extra nutrients to overcome the growth restrictions imposed by disease, then the RNIs for such children should reflect these additional needs.

- > The RNIs for children living in low- and middle-income countries should be somewhere between the values proposed by WHO and other international bodies (minimum) and the amounts needed to rehabilitate a child following hospitalization for severe malnutrition (maximum).


Introduction

To reduce the enormous loss of life of children younger than five years, the World Health Organization (WHO) recommends that infants should be fed breast milk exclusively for the first six months of life and that breastfeeding should continue for 18 months or longer. Complementary foods should not be introduced until a child is six months old and the amounts should be increased gradually until they are eating a typical family food. These recommendations were discussed in the previous two issues of *Sight and Life* magazine.^{1,2}

The nutritional recommendations for infancy are promoted to enable a child entering its preschool years to be healthy and grow well. The recommendations however may not be adequate for children in the developing world. Child growth has been used as an indicator of undernutrition for decades and regrettably in low- and middle-income countries worldwide, stunting affects 27% of children under five years.³ Stunting is typically defined as ≤ 2 standard deviations (SD) below the median of height-for-age, based on WHO child growth standards.⁴ Stunting, anemia, and poor vitamin A status are key risk factors for diminished survival, poor child and adult health, and reduced cognitive development.^{5–7} In this article I look at some of the information suggesting that additional nutrients above the Recommended Nutrient Intakes (RNI) for children 6–59 months are necessary to support child growth in low- and middle-income countries.

Nutritional requirements for children 24–59 months

The WHO,⁸ Institute of Medicine, and other official country bodies have recommended nutrient intakes for children 1–6 years of age (Table 1). It is important to realize however that these RNIs are intake guidelines for normal, healthy children living in a clean environment. Children in developed countries gen-



“In low- and middle-income countries worldwide, stunting affects 27% of children under five years”

TABLE 1: Recommended Nutrient Intakes (RNIs) for normal children 1 to 6 years of age.[#]

Vitamin	Water-soluble vitamins								
	Vitamin C	Thiamin	Riboflavin	Niacin	Vitamin B ₆	Pantothenate	Biotin	Vitamin B ₁₂	Folate
Units	mg/day	mg/day	mg/day	mg NE ^{###} /day	mg/day	mg/day	µg/day	µg/day	µg DFE ^{###} /day
1–3 years	30	0.5	0.5	6.0	0.5	2.0	8.0	0.9	150
4–6 years	30	0.6	0.6	8.0	0.6	3.0	12.0	1.2	200

Minerals	Calcium	Selenium	Magnesium	Zinc			Iron				
	Dietary bio-availability	n/a	n/a	n/a	high	moderate	low	15%	12%	10%	5%
Units	mg/day	µg/day	mg/day	mg/day	mg/day	mg/day	mg/day	mg/day	mg/day	mg/day	mg/day
1–3 years	500	17	60	2.4	4.1	8.3	3.9	4.8	5.8	11.6	
4–6 years	600	22	76	2.9	4.8	9.6	4.2	5.3	6.3	12.6	

[#]Recommended Nutrient Intake (WHO/FAO) is the intake that meets the needs of almost all (97.5%) apparently healthy individuals in the age-specific populations shown.

^{##}Data for vitamin E were not strong enough to formulate recommendations. The figures represent the best estimates of requirements.

^{###}Abbreviations: niacin equivalents (NE); dietary folate equivalents (DFE); retinol equivalents (RE); tocopherol equivalents (TE)

erally live in clean conditions, eat uncontaminated foodstuffs from clean containers, and are exposed to fewer pathogens than those living in low- and middle-income countries. When children in developed countries get sick they get prompt medical attention and during convalescence they receive nutritious foodstuffs. Illness during infancy is common both in developed and developing countries and when severe, growth is temporarily halted but the risk of prolonged acute or chronic infection or reinfection is lower in developed countries due to better quality food and cleaner environments. Hence, during convalescence in developed countries, nutritious food provides nutrients necessary to rebuild tissues catabolized during the infection. This catch-up growth quickly resumes normal growth trajectories.

Consequences of poor sanitation and frequent infections on child physiology and metabolism

One of the consequences of poor hygiene and lack of sanitation is a higher risk of diarrhea. Diarrhea, particularly when accompanied by fever, has important implications for nutritional requirements. Diarrhea will compromise the balance of energy and other nutrients by three mechanisms: (1) reduced appetite and thus dietary intakes; (2) increased fecal losses because of malabsorption of micronutrients and macronutrients, decreased intestinal transit time, and loss of nutrients into the gut; and (3) increased catabolism because of acceleration of the basal metabolic rate.⁹ A 1°C rise in body temperature can increase basal metabolism by 10%.¹⁰ To fuel the increased metabolism when dietary intake is reduced, the body breaks down carbohydrate and protein in tissues. Feeding carbohydrate or fat will spare

body protein¹⁰ so if an infant is being exclusively breastfed or older children are supplemented with additional sources of energy, the negative effects of diarrhea on body weight are minimized.⁹ In general, however, the first two mechanisms cause a reduction in nutrient availability and the third an increase in nutrient requirements, particularly for energy and protein and the nutrients associated with heat production.⁹

The incidence of diarrhea peaks at 6–11 months as infants eat an increasing amount of potentially contaminated food and begin to crawl and explore their environment, thus placing them in direct contact with multiple sources of pathogens.¹¹ Most diarrhea is self-limiting, that is, the child recovers when the infection has run its course, but when the diarrhea has stopped and the child starts eating again, he needs food both to support basal metabolism and to rebuild the tissues lost during sickness. Rebuilding tissues requires not only the basic components of carbohydrate, protein, and fat but also the micronutrients that have important roles in tissue synthesis. So to rebuild skeletal tissues, cartilage must be synthesized followed by ossification with calcium and phosphorus. Cartilage is predominantly derived from carbohydrate but with a small amount of highly sulfated protein. The sulfur is derived from the essential amino acids methionine and cysteine. If sulfur is in short supply the amino acids will be used preferentially to synthesize lean tissue. Furthermore, there are several other nutrients potentially needed in higher amounts to build up skeletal tissue: phosphorus, calcium, magnesium, vitamin D, vitamin K, vitamin C, zinc, and copper.¹² Unfortunately, many locally prepared complementary foods contain barely enough nutrients to support basic nutrition, let alone catch-up

Fat-soluble vitamins			
Vitamin A	Vitamin D	Vitamin E ^{##}	Vitamin K
µg RE ^{###} /day	µg/day	mg α-TE ^{###} /day	µg/day
400	5.0	5.0	15
450	5.0	5.0	20
Iodine			
µg/day			
90			
90			

Data from reference⁸ with permission.

growth.^{13,14} Hence, where food quality is poor and infection rates are high, the synthesis of new tissue is restricted, increasing the risk of stunting as the child ages.

In a low- or middle-income country setting, stunting may go unrecognized where short stature is common but wasting or underweight (weight-for-height) is more easily recognized. However, stunting is probably more prevalent than underweight in such countries,¹⁵ but if a child is stunted and has a normal weight-for-height, then that child must also be underweight for its age.¹² That is, stunted children are moderately malnourished children and WHO RNIs may not be adequate for such children to regain their lost height and weight.

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“Stunted children are moderately malnourished children and WHO Recommended Nutrient Intakes may not be adequate for such children to regain their lost height and weight”

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The process of being stunted typically begins *in utero* but stunting also reflects the cumulative effects of poor nutrition and frequent infections throughout infancy. Infections are common in infants in both developed and developing countries¹⁶ but are even more common in the latter.^{2,17} As previously indicated, the peak incidence of diarrhea is at 6–11 months as infants begin to crawl and explore their environment,¹¹ although growth

faltering begins around 3–4 months^{4,18} when infants are given an increasing amount of potentially contaminated food and/or water, thus placing them in direct contact with multiple sources of pathogens. However, there is convincing evidence that breast milk provides protection against gastrointestinal infection and diarrheal disease.¹⁹

The evidence supports the WHO recommendation for exclusive breastfeeding in the first six months²⁰ and for continued breastfeeding over the first two years of life.²¹ The exact mechanism by which breast milk exerts these benefits on infant health is still not known. As previously indicated, it is a source of good nutrition to counter the adverse effects of diarrhea and other diseases on growth. In addition, human milk contains a plethora of molecules with immunological properties, e.g., secretory immunoglobulin A (sIgA), lactoferrin, lysozyme, α-lactalbumin, complex lipids, and free oligosaccharides.²² Secretory IgA is present in high concentrations in colostrum and complements the lack of sIgA in newborn infants. In addition, free oligosaccharides, which act as decoy receptors for epithelial binding sites to trap pathogenic bacteria, are also found in higher concentrations in colostrum than in mature milk. Oligosaccharides reduce colonization by pathogens while simultaneously promoting beneficial members of microbiota including *Bifidobacterium* species. These particular properties of colostrum and breast milk may be the reason for lower levels of gastrointestinal disease even in developed countries when exclusive breastfeeding is given^{16,23} even though in some cases, exclusive breastfeeding was only 13 weeks.²³ In a developed country with better sanitation and hygienic practices than found in low- and middle-income countries, infants are probably exposed to fewer pathogens and exclusive breastfeeding will minimize the effects of exposure still further. In contrast, where pathogen exposure is high, exclusive breastfeeding is needed both to provide protection against gastrointestinal infections and provide nutritional adequacy for the infant over the first six months.

Gut enteropathy

Unfortunately, as discussed in the previous two articles,^{1,2} exclusive breastfeeding is rare in low- and middle-income countries. Breastfeeding may continue for one to two years but potentially contaminated water or other milks can be given from the early months of parturition. Complementary feeds have low energy densities and may be given too early and in insufficient amounts. That is, infant nutrition is not adequate and there is now accumulating evidence that nutrition and infections during the first two years of life may have pronounced effects on the microbiota of the infant and young child gut and that this may influence both development and nutrition. Gut enteropathy has been shown to be common in apparently healthy infants in many low- and middle-income countries, e.g., the Gambia,^{17,18} India,²⁴

Nepal,²⁵ and Zambia.²⁶ Morphological changes associated with the enteropathy include reductions in the height of the gut villi and impaired mucosal integrity.¹⁸ Others have shown increases in the number of intra-epithelial lymphocytes and lamina propria T cells, predominantly T-helper cell phenotype (Th1),²² suggesting an inflammatory etiology. No single pathogen or constellation of pathogens has been identified in the microbiota of individuals with enteropathy,²⁷ nevertheless enteropathy and poor growth and development of infants are frequently associated. In the apparently healthy Gambian infants, 43% of the deficit in height-for-age (stunting) could be explained by the long-term poor gut integrity or enteropathy.¹⁸ That is, gut enteropathy may well impair absorption and impose limitations on child growth in addition to those of poor dietary intakes.

The effects of enteropathy on the morphology of the gut epithelium potentially impair absorption of nutrients. Not only is the absorptive surface area of the epithelium reduced, enzymes like lactase that are found predominantly at the tips of the villi are reduced. Lactase is needed to metabolize milk sugar, i.e., lactose, to release glucose and galactose. Lactose is an important source of energy for the growing infant and when lactase is absent lactose cannot be absorbed directly through the wall of the gut into the bloodstream. So it passes on to the colon where bacterial fermentation increases gases like carbon dioxide and methane, causing bloating and flatulence, and the increased osmolarity in the lumen draws water into the colon causing diarrhea. Thus, reduced lactase activity in the gut epithelium potentially impairs an important source of energy for the infant and increases the risk of diarrhea. Therefore, the nutritional recommendations for a healthy child living in a clean environment may not be sufficient for a child with gut enteropathy that is already marginally malnourished. At best, the dietary recommendations may only maintain the infant in the current marginally malnourished state.

Interaction of nutrition and infection

The widespread evidence of stunting indicates that many children in low- and middle-income countries are malnourished when they leave infancy. International dietary recommendations are probably not sufficient to do more than maintain the current anthropometric status. In a recent paper, workers explored the evidence available to determine whether intervention with dietary supplements could improve nutrition, strengthen a child's ability to fight infection, and reduce the negative effects of infection on growth.¹¹ To do this the authors examined evidence available on the interaction between growth and the two most common categories of infection: diarrheal and respiratory infections. Diarrhea is usually self-limiting, that is, the infection runs its course and the child will return to normal without requiring specific treatment. The au-

thors pointed out it is normal for children to exhibit growth faltering in both weight and height and to grow more rapidly after recovery. However, the extent of catch-up growth will depend on the age of the child, the child's initial nutritional status, specific pathogens causing the infection, the duration of the infection, and the length of diarrhea-free time following infection.²⁸ These observations were made in a community-based study in Lima, Peru, where *Cryptosporidium parvum* infection had lasting adverse effects on linear (height) growth especially when acquired during infancy and when children were stunted before they became infected.²⁸ That is, the higher the burden of diarrhea in the first two years of life, the higher the risk of stunting at 24 months of age. In a pooled analysis of data from nine studies in five countries (Bangladesh, Brazil, Ghana, Guinea-Bissau, Peru), 25% of stunting at two years of age was attributed to having five or more episodes of diarrhea in the first two years.²⁹

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 “Data from nine studies in five countries [showed] 25% of stunting at two years of age was attributed to having five or more episodes of diarrhea in the first two years”

The impact of respiratory infections on growth was less clear. An Indonesian study in preschool children (PSC) 6–48 months reported that the effects of high-dose vitamin A supplements depended on the burden of respiratory infection.³⁰ A group of 1,405 children received 200,000 IU vitamin A or placebo every four months. The authors found that in children with a low burden of respiratory infection, linear growth improved after supplementation. However, in those with a high burden of respiratory infection there was little or no impact. Dewey and Mayer suggest that the explanation for the observations may relate to the impact of respiratory disease on vitamin A absorption and/or excretion.¹¹ Fever can accelerate the excretion of vitamin A in the urine³¹ and block the release of vitamin A into the blood³² so the more severe the disease, the less was the benefit obtained from vitamin A. However, supplements of vitamin A are supposed to reduce morbidity so it is difficult to understand why there were no prophylactic effects of vitamin A in those who received the supplement.

Impact of nutritional intervention on diarrhea-associated growth impairment

Four studies were reported by Dewey and Mayer to have shown a beneficial impact of nutritional intervention on growth (Ta-

TABLE 2: Impact of nutritional supplements on diarrhea-associated growth impairment.#

Trial characteristics	Colombia ³²	Guatemala ⁹	Tanzania ³³	South Africa ³⁴
Trial type	Randomized food supplementation study	Two supplement feeding trials in four villages	Randomized VA supplementation	Randomized double-blind MMN supplementation
Subject eligibility	1 st and 2 nd trimester of pregnancy and of her PSC were underweight	Pregnant and lactating women and their children ≤ 7 years	Children 6–60 mo admitted to hospital with pneumonia	Children 6–24 mo
Supplement details	From 6 mo of pregnancy to 36 mo of age: skim milk, enriched bread and oil. Children received iron (daily) VA every 6 mo from 6 mo of age	<i>Atole</i> – high protein and high-energy drink; <i>Fresco</i> – no protein low-energy drink; both +MMN	High-dose VA (200,000 IU) on entry and at 4 and 8 mo after discharge or placebo	VA alone; VA plus zinc; MMN including VA and zinc
Subject details	No supplement n = 148 children; Supplement n = 140 (diarrhea 18 and 16 episodes respectively, NS)	Food supplement drinks were given to pregnant women and young children > 4 mo; each in two villages	687 child patients recruited in hospital and followed up for 8 mo	32 HIV+ children; 154 HIV- children of HIV+ mothers; 187 HIV- children of HIV-mothers
Outcome	Unsupplemented – strong inverse relationship between height and number of days with diarrhea ($P < 0.001$); Supplemented – no relationship	<i>Fresco</i> – Significant negative relationship at 3 years between % of time with diarrhea and length gain <i>Atole</i> – no relationship	In placebo group, stunting was 3.7 times higher in children with persistent diarrhea than those without	Among children experiencing > six episodes of diarrhea, those receiving MMN had no decline in LAZ compared to 0.6 and 0.5 z-score declines in children receiving VA alone or VA with zinc respectively.
Conclusions	Supplementation countered the negative impact of diarrhea – no positive effect in absence of diarrhea.	Comparable findings with Colombian study. NB, riboflavin 1.5 mg/day in both supplements but there was no added zinc. Small positive effect on growth in those with little diarrhea	VA eliminated risk of stunting in children with persistent diarrhea during follow-up. VA may facilitate catch-up growth by reducing morbidity.	Daily MMN supplementation combined with VA was of greater benefit in preventing decline in growth, compared to VA alone or to VA plus zinc.

Abbreviations: preschool children (PSC); vitamin A (VA); multiple micronutrients (MMN); length-for-age z-score (LAZ); not significant (NS)

Source of information shown in column headings.

ble 2).¹¹ The interventions did not appear to prevent diarrhea but may have countered its negative impact on growth by possibly enabling catch-up growth. The countries involved were Colombia,³³ Guatemala,⁹ Tanzania,³⁴ and South Africa.³⁵ In Colombia and Guatemala, the foci of attention were the potential benefit of energy and protein, while in the African countries it was vitamin A and zinc. However, other micronutrients were also given in three of the studies and only the Tanzanian study was restricted to one nutrient, vitamin A. The common feature of the studies was that the subjects were preschool children;

in South Africa from 6–24 months, the South American studies from pregnancy to 36 months and in Tanzania from 6–60 months. As the studies were done in four very different environments, it is probably not possible to attribute any benefit to a specific nutrient(s) but rather to a combination of factors including improved nutrition, less severe morbidity and more rapid recovery following infection enabling catch-up growth to occur. The conclusion is that improved nutrition through infancy in low- and middle-income countries will help prevent stunting in children entering the preschool period.

TABLE 3: Interaction of quartile of diarrheal disease and supplementation category on mean length of Colombian children at 36 months of age.[#]

Number of days of diarrhea ^{##}	Supplemented		Unsupplemented		Difference in length (cm) ^{###}
	N	Length (cm)	N	Length (cm)	
≤ 38	32	88.0	27	87.3	0.7
> 38–60	34	87.8	28	85.4	2.4 *
> 60–105	30	88.6	30	86.0	2.6 **
> 105	27	87.7	34	82.8	4.9 ***

[#]Length and diarrheal morbidity were compared at 36 mo of age in two cohorts of urban Colombian children who were supplemented or unsupplemented (see Table 2) from sixth month of pregnancy until they were 36 mo old. Information was obtained from reference Lutter et al.⁹ with permission. Data were an analysis of information from study first described in reference Mora et al. 1979³⁸. All families were enrolled in a uniform healthcare program comprising free medical care for the mothers and all children < 7 years of age. Supplementation details are given in text.

^{##}Diarrhea was defined as the number of days of diarrhea between birth and 36 mo of age. There was no difference between the supplemented and unsupplemented groups in the number of days of diarrhea.

^{###}Interaction for two-way analysis of variance model ($P < 0.001$). * $P < 0.005$, ** $P < 0.001$; *** $P < 0.0001$

Modifying WHO nutritional recommendations enables catch-up growth in marginally and moderately malnourished children

The four studies described in Table 2 gave different supplements in their efforts to improve growth of PSC. In general the main benefit was one of prevention of the negative effects of diarrhea on growth. Table 3 shows the impact of days with diarrhea on mean lengths of supplemented and unsupplemented Colombian children at 36 months. In the presence of little or no diarrhea, there was no effect of the supplement on length growth. However, as the prevalence of diarrhea increased, the difference in length between the two groups increased and where the number of days with diarrhea was > 105, the mean difference in length between the groups was almost 5 cm. That is, the supplement countered the negative effects of diarrhea on growth. The study in Guatemala was comparable with that in Colombia except that the dietary calorie intake of the unsupplemented Colombian children was almost twice that of the Guatemalan children (1,329 versus 778 kcal/day) and the net increase from supplementation was 230 kcal/day in Colombia compared with 124 kcal/day in Guatemala.⁹ In Guatemala, in contrast to the Colombian study, in the absence of diarrhea, growth was 1.5 cm greater in those children supplemented with *atole* (high-energy supplement) than in those children supplemented with *fresco* (no additional energy). Thus in Guatemala, there was a positive effect on body length at low levels of diarrhea among children consuming the high-energy supplement. The effect can probably be attributed to the larger deficit in their energy intakes where even the small increase of 124 kcal/day had a positive effect on growth.

In all of the other studies, the supplement did not have any growth effects in the absence of diarrhea indicating that if

growth was limited by nutritional deficiencies, the supplements did not rectify those deficiencies. Golden makes similar points in his article on nutritional recommendations for moderately malnourished children.¹² Apparently healthy children who are stunted (≤ 2 SD height-for-age) have lost, or not attained, their normal height-for-age. If such children have normal weight for their height, then they will be deficient in both weight and height for their age. Such children can be defined as marginally or moderately malnourished. To accrete or regain lean tissue and bone, children will need extra amounts of all nutrients as a balanced supplement for the syntheses to occur. He points out that if the supplement is not balanced, and for example contains an excess of oil to supply extra energy, the surplus energy will be laid down as fat producing an obese child with an excessive weight-to-height ratio. Likewise, single nutrient supplements can only make good any deficit of that nutrient in the current dietary intake. If zinc for example is the only deficient nutrient in a child's intake, then a zinc supplement may have dramatic results. However, it is far more likely in a marginally malnourished child that zinc is just one of many deficient nutrients, and replacing one only may only expose the next most limiting nutrient.¹²

Supplements therefore should always contain multiple micronutrients (MMN) but this should not just be a cocktail of the common vitamins and minerals for which there may be demonstrable deficiency diseases, but should also include all the more unusual micronutrients like biotin, pantothenate, manganese, copper, etc. In a mixed diet, such as those consumed in the Western world and by the more wealthy people in developing countries, all the micro- and macronutrients are usually present, allowing tissue synthesis when it is needed. However, many nutrients are limiting in the thin monotonous gruels fed day

TABLE 4: Recommended Nutrient Intakes (RNI) for normal children, for treating hospitalized, severely malnourished children, and for treating moderate malnutrition in the community.#

Nutrient	RNI for normal children (WHO/FAO)	F100 or RUTF for treatment of severe malnutrition	Proposed RNI for moderate acute malnutrition (RNI-MAL)		
			Food	Supplement	
Protein	Protein (g)	22.3	28.4	24	26
	Nitrogen (g)	3.6	4.6	3.9	4.2
Minerals	Sodium (mg)	–	434	550	550
	Potassium (mg)	–	2,400	1,400	1,600
	Magnesium (mg)	79	175	200	300
	Phosphorus (mg)	450	762	600	900
	Sulfur (mg)	0	0	0	200###
	Zinc (mg)	12.5	22.3	13	20
	Calcium (mg)	595	1,009	600	840
	Copper (µg)	–	2,740	680	890
	Iron (mg)	17.8	24##	9	18
	Iodine (µg)	201	190	200	200
	Selenium (µg)	17.8	55	30	55
	Manganese (mg)	–	0.69	1.2	1.2
	Chromium (µg)	–	0	0	11
	Molybdenum (µg)	–	0	0	16
Water-soluble vitamins	Thiamine (B ₁) (µg)	523	700	600	1,000
	Riboflavin (B ₂) (µg)	595	2,000	800	1,800
	Pyridoxine (B ₆) (µg)	595	700	800	1,800
	Cobalamin (B ₁₂) (µg)	0.966	1,000	1,000	2,600
	Folate (µg)	167	350	220	350
	Niacin (mg)	6.4	10	8.5	18
	Ascorbate (mg)	45	100	75	100
	Pantothenic acid (mg)	2.7	3	2.7	3.0
	Biotin (µg)	9.7	24	10	13
Fat-soluble vitamins	Retinol (A) (µg)	595	1,500	960	1,900
	Cholecalciferol (D) (µg)	7.4	30	7.4	11
	Tocopherol (E) (mg)	8.9	22	11.5	22
	Phytomenadione (K) (µg)	16.1	40	20	40
Essential fatty acids	N-6 Fatty acids (g)	–	5.0	5	5
	N-3 Fatty acids (g)	–	0.85	8.5	8.5

Values shown are expressed as nutrient:energy densities (amount of nutrient/1,000 kcal). F100 and RUTF is composition of ready-to-use therapeutic food. The Food column indicates the amount of nutrient that should be in the diet when programs are based on a mixture of local foods to treat the moderately malnourished without general fortification of the diet. The Supplement column is the suggested nutrient density that should be achieved in the diet when specially fortified supplementary foods are used in a program to treat moderately malnourished or convalescent children (with permission).¹² The author also suggests amounts of essential amino acids should be present in RNI-MAL but these are not shown here.

Iron is only added to RUTF, not F100.

The sulfur should be in addition to that present in protein.

TABLE 5: Consumption of fortified milk and noodles on prevalence of stunting in children 6–59 months in Indonesia.[#]

Rural or urban communities	Number of families	Fortification ^{##}	Prevalence of stunting (%)					
			Milk products		Noodles		Milk products and noodles	
			%	<i>P</i> < ###	%	<i>P</i> < ###	%	<i>P</i> < ###
Rural	222,250	Fortified	43.4	0.0001	45.6	0.0001	37.7	0.0001
		Not fortified	56.2		53.6		53.5	
Urban	79,950	Fortified	42.8	0.0001	45.9	0.0001	40.2	0.0001
		Not fortified	53.7		51.5		51.2	

[#]Stunting was defined as ≤ 2 SD height for age.³⁶

^{##}Milk products were compulsorily fortified with vitamins A, D, E, K, B₁₂, B₁, and B₂. Noodles were voluntarily fortified with vitamins A, B₆, B₁₂, B₁, niacin, folate, and iron.

^{###}Chi square tests.

after day to weaning infants and PSC in poor countries.^{13,14} Not only are the diets limiting in nutrient content but there are also volume limitations in how much a child can consume. Diverse, nutrient-dense diets are needed to enable children to make good the losses caused by infection and disease.

“Diverse, nutrient-dense diets are needed to enable children to make good the losses caused by infection and disease”

The approach used by Golden¹² to devise RNIs for moderately malnourished children (RNI-MAL) is to regard the nutritional requirements of such children as between those RNIs proposed by the WHO⁸ (minimum requirements) and the nutrient concentrations needed to rehabilitate severely malnourished children in hospital (maximum requirements). F100 was a formula devised for use in the rehabilitation following treatment of severe childhood malnutrition.³⁶ The composition of F100 is shown in Table 4 together with the proposed recommendations for RNI-MAL. The efficacy of F100 has been proven “experimentally” by the successful rehabilitation of severely malnourished children in many treatment centers throughout the world. The recommendations listed for RNI-MAL are based on metabolic considerations with regard to the nutritional needs for catch-up growth, but still need to be tested in a community. In the hospital situation, close medical supervision facilitates treatment and provides a conducive environment for recovery and rehabilitation. In a community study, children will still be in the same unhygienic environment and exposed to the same high levels of pathogens. An enriched supplement may provide the materials

for recovery but a child needs to be healthy to facilitate catch-up growth. Diet alone may have limited success in countering the effects of hostile, unhygienic environments.

Should the RNI-MAL be successful under field conditions in promoting catch-up growth in the majority of supplemented children, the big question is how to implement the use of the RNI-MAL in the community. Ideally use of local foods (if available) to provide the components of the RNI-MAL should be encouraged. Provision of a supplement to the millions of moderately malnourished children in the world is expensive, but legislation as well as voluntary fortification may be a way to approach the problem, as illustrated recently in Indonesia.³⁷ Information was collected on consumption of fortified milk products and fortified noodles by children 6–59 months of age in 222,250 rural families and 79,950 families living in urban slum areas of Indonesia. The prevalence of stunting in the rural and urban areas was 51.8% and 48.8% respectively but was significantly lower in children consuming fortified milk products or fortified noodles or both (Table 5). Milk products are compulsorily fortified with vitamins A, D, K, E, B₁₂, B₁, and B₂ and noodles are voluntarily fortified with vitamins A, B₆, B₁₂, B₁, niacin folate, and iron.³⁷ The evidence collected showed that the risk of stunting was only slightly but significantly reduced because of the large numbers of people involved. It is interesting to note that the only mineral fortificant was iron and perhaps a greater effect on stunting would have been achieved using the RNI-MAL nutrients listed in Table 4.¹²

In developed countries the complex mixture of micronutrients and other dietary components is obtained by consuming a mixed diet. Promoting dietary diversity in low- and middle-income countries should be a priority and accompanied by improvements in sanitation and hygiene to reduce infections. Fortification of foods can assist in improving dietary quality but the nutrients to be added should be carefully selected to meet the nutritional requirements of moderately malnourished children.

Conclusions

Evidence suggests that the RNIs proposed by WHO and other international bodies are not sufficient to rectify the effects of malnutrition, which impairs child growth during the first two years of life. Even if a child is given exclusive breastfeeding in the first six months, poor sanitation and unhygienic conditions result in frequent infections and hence growth falters so that stunting is present in more than a quarter of PSC in low- and middle-income countries. Supplementation studies with a number of nutrients have shown that the negative effects of diarrhea on child growth can be minimized but both single- and multiple-nutrient supplementation studies rarely rectify previous growth faltering. It is argued that a stunted child, even if apparently healthy, is suffering from moderate malnutrition and to enable catch-up growth to take effect, the RNIs proposed by WHO should be increased to somewhere between the proposals of WHO and the recommendations for the rehabilitation of the severely malnourished child.

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References

01. Thurnham DI. Adequate nutrient intakes for infancy. Part 1, from 0 to 6 months. *Sight and Life* magazine 2012;26(3),28–39
02. Thurnham DI. Adequate nutrient intakes for infancy. Part 2: Complementary food from 6 to 24 months. *Sight and Life* magazine 2013;27(1),30–41.
03. UNICEF. Improving child nutrition. The achievable imperative for global progress. United Nations Children's Fund, ed. New York. 2013. 1–132.
04. Victora CG, De Onis M, Hallal PC et al. Worldwide timing of growth faltering: revisiting implications for interventions. *Pediatrics* 2010;125:e473–e80.
05. Dewey KG, Begum K. Long-term consequences of stunting in early life. *Matern Child Nutr* 2011;7:5–18.
06. Soares Magalhães RJ, Clements ACA. Mapping the risk of anaemia in preschool-age children: The contribution of malnutrition, malaria, and helminth infections in West Africa. *PLoS Med* 2011;8:e1000438.
07. Thurnham DI. Vitamin A supplementation. Beneficial effects on mortality and morbidity in children aged six months to five years. *Sight and Life Magazine* 2011(3);38–46.
08. WHO/FAO. Human vitamin and mineral requirements; Report of a joint FAO/WHO expert consultation Bangkok, Thailand 21–30 September 1998. 2nd ed. Rome: World Health Organization/Food and Agriculture Organization of the United Nations, 2004.
09. Lutter CK, Habicht JP, Rivera J et al. The relationship between energy intake and diarrhoeal disease in the effects on child growth: biological model, evidence and implications for public health policy. *Food Nutr Bull* 1992;14:36–42.
10. Du Bois EF. Fever and the regulation of body temperature. Springfield, Illinois, USA: Charles C Thomas, 1948.
11. Dewey KG, Mayers DR. Early child growth: how do nutrition and infection interact? *Matern Child Nutr* 2011;7:129–42.
12. Golden MHN. Proposed recommended nutrient densities for moderately malnourished children. *Food Nutr Bull* 2009;30:S267–S342.
13. Gibson RS, Ferguson EL, Lehrfeld J. Complementary foods for infant feeding in developing countries: their nutrient adequacy and improvement. *Eur J Clin Nutr* 1998;52:764–70.
14. Arsenault JE, Yakes EA, Islam MM et al. Very low adequacy of micronutrient intakes by young children and women in rural Bangladesh is primarily explained by low food intake and limited diversity. *J Nutr* 2013;143:197–203.
15. Lutter CK, Daelmans BM, De Onis M et al. Undernutrition, poor feeding practices, and low coverage of key nutrition interventions. *Pediatr* 2011;128:1418–27.
16. Dewey KG, Heinig MJ, Nommsen-Rivers LA. Differences in morbidity between breast-fed and formula-fed infants. *J Pediatr* 1995;126:696–702.
17. Darboe MK, Thurnham DI, Morgan G et al. Effectiveness of an early supplementation scheme of high-dose vitamin A versus standard WHO protocol in Gambian mothers and infants: a randomised controlled trial. *Lancet* 2007;369:2088–96.
18. Lunn PG, Northrop-Clewes CA, Downes RM. Intestinal permeability, mucosal injury and growth faltering in Gambian infants. *Lancet* 1991;338:907–10.
19. World Health Organization Study Team. Effect of breastfeeding on infant and child mortality due to infectious diseases in less developed countries: a pooled analysis. WHO Collaborative Study Team on the Role of Breastfeeding on the Prevention of Infant Mortality. *Lancet* 2000;355:451–55.
20. World Health Organization. The optimal duration of exclusive breastfeeding. Report of an expert consultation. Geneva: World Health Organization, 2001.
21. PAHO/WHO. Guiding principles for complementary feeding of the breastfed child. Pan American Health Organization/World Health Organization. 2003.
22. Gordon JL, Dewey KG, Mills DA et al. The human gut microbiota. *Sci Transl Med* 2012;4:137ps12.
23. Howie PW, Forsyth JS, Ogston SA et al. Protective effect of breast feeding against infection. *B M J* 1990;300:11–6.
24. McCullough FSW, Northrop-Clewes CA, Thurnham DI. The effect of vitamin A on epithelial integrity. *Proc Nutr Soc* 1999;58:289–93.
25. Goto R, Panter-Brick C, Northrop-Clewes CA et al. Poor intestinal permeability in mildly stunted Nepali children: associations with weaning practices and *Giardia lamblia* infection. *Brit J Nutr* 2002;88:141–9.

26. Nchito M, Friis H, Michaelsen KF et al. Iron supplementation increases small intestine permeability in primary schoolchildren in Lusaka, Zambia. *Trans R Soc Trop Med Hyg* 2006;100:791–4.
27. Kau AL, Ahern PP, Griffin NW et al. Human nutrition, the gut microbiome and the immune system. *Nature* 2011;474:327–36.
28. Checkley W, Epstein LD, Gilman RH et al. Effects of *Cryptosporidium parvum* infection in Peruvian children: growth faltering and subsequent catch-up growth. *Am J Epidemiol* 1998;148:497–506.
29. Checkley W, Buckley G, Gilman RH et al. Multi-country analysis of the effects of diarrhoea on childhood stunting. *Int J Epidemiol* 2008;37:816–30.
30. Hadi H, Dibley MJ, West. Complex interactions with infection and diet may explain seasonal growth responses to vitamin A in preschool aged Indonesian children. *European Journal of Clinical Nutrition* 2004;58:990–9.
31. Stephensen CB, Alvarez JO, Kohatsu J et al. Vitamin A is excreted in the urine during acute infection. *Am J Clin Nutr* 1994;60:388–92.
32. Rosales FJ, Ritter SJ, Zolfaghari R et al. Effects of acute inflammation on plasma retinol, retinol-binding protein, and its messenger RNA in the liver and kidneys of vitamin A sufficient rats. *J Lipid Res* 1996;37:962–71.
33. Lutter CK, Mora JO, Habicht J-P et al. Nutritional supplementation: effects on child stunting because of diarrhea. *Am J Clin Nutr* 1989;50:1–8.
34. Villamor E, Mbise R, Spiegelman D et al. Vitamin A supplements ameliorate the adverse effect of HIV-1, malaria, and diarrheal infections on child growth. *Pediatrics* 2002;109:E6.
35. Chhagan MK, Van den Broeck J, Luabeya KK et al. Effect on longitudinal growth and anemia of zinc or multiple micronutrients added to vitamin A: a randomized controlled trial in children aged 6–24 months. *BMC Public Health* 2010;10:145–55.
36. World Health Organization. Management of severe malnutrition: a manual for physicians and other senior health workers. Geneva: World Health Organization, 1999.
37. Semba RD, Moench-Pfanner R, Sun K et al. Consumption of micronutrient-fortified milk and noodles is associated with lower risk of stunting in preschool-aged children in Indonesia. *Food Nutr Bull* 2011;32:347–53.
38. Mora JO, de Peredes B, Wagner M et al. Nutritional supplementation and outcome of pregnancy. I. Birth weight. *Am J Clin Nutr* 1979;32:455–62.

Opinion: David Thurnham’s Reflections on “Adequate Nutrition for Children 24 to 59 Months”

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David Thurnham’s article touches on a more complex topic than the prevention of stunting in children. In essence, it begs the question: Are the Recommended Nutrient Intake (RNI) values – designed to guarantee the health and nutritional status of apparently normal children, as well as to promote their growth and well-being – applicable to virtually all 24- to 59-month-old children worldwide?

I would argue that RNI values should be able to discriminate according to population group. Are new developments, techniques, and understandings overall applicable and appropriate for developing countries? The time will come when RNIs for developing countries will need to be based on developing country data. The energy RNIs could be a good example of contradictions. Years ago, before the last edition of the 2004 FAO/WHO RNIs,¹ I participated in a Latin American exchange on proposals to use total energy expenditure (TEE) data obtained by the

doubly labeled water method from preschoolers living mainly in cities of highly industrialized or developing countries (UK, USA, Chile),² to set energy requirement values for normal preschoolers the world over.

These TEE values, measured by this isotopic gold standard method in children aged one to five years, were certainly more accurate than the previous energy intake data collected by Durnin and Ferro-Luzzi on energy RNIs for the previous 1985 FAO/WHO/UNU Expert Consultation.³ But such isotopic studies were carried out in only 143 boys (UK 81, USA 48, Santiago de Chile 14) and 165 girls (UK 87, USA 64, Santiago de Chile 14),² all of them city dwellers. Thus, while quality of biochemical and physiological data improved, necessary social data did not.

“RNIs should be considered in a broader framework”

Rural, and small-town children in the developing world, not yet stunted or undernourished, are certainly more metabolically

susceptible to surrounding bacterial and parasitic infections; lack adequate environments, nutrition and healthcare equivalent to the children studied; and undoubtedly are not as sedentary as those children living in big urban settings (irrespective of country).⁴ For such preschoolers, the energy RNIs, according to the generalized recommendations, would be far below their actual requirements. Thus, RNIs should be considered in a broader framework, taking into account specific circumstances of specific populations.

In fact, a reduction in recommended dietary energy for preschoolers – as proposed by the 2004 FAO/WHO RNIs, aimed at preventing overweight and NCDs from infancy forward, and to date without a practical and effective proposal to increase physical activity (accompanied by an adequate energy supply!) – would ultimately simply reinforce the status quo of sedentary urban children, and clearly not consider the higher TEE values of developing world (rural and small town) children.

A high TEE value of 82 kcal/kg/day was measured in Gambian infants (65% undernourished, 90th percentile weight for age; and 36% stunted, 90th percentile weight for height). In a Mexican study in infants with low weight-for-age and length-for-age z-scores, TEE per kg body weight was significantly higher in Mexican than in American breastfed infants.⁵ Energy expenditure of malnourished Peruvian infants undergoing catch-up growth is elevated compared to those who are well nourished.⁶ Similar results are found in Chinese infants from DLW studies.⁷ Up to 20 times normal growth rates have been observed in wasted infants; stunted children's growth rate is about three times normal rates. The energy cost of this recovery must be considered within the RNIs.^{6,8}

“More research is in children affected by diverse disorders and social conditions”

RNIs for stunted children should be between those proposed for normal children and the nutrient concentrations needed to rehabilitate severely malnourished children in hospital (maximum requirements), but I think more research is certainly needed in children affected by diverse disorders and social conditions, comparable at least to studies already done in apparently normal children.

RNIs should not only be revised and restructured to prevent stunting, but primarily to consider the more general objective of pertinence to the real requirements of the majority of the world's children.

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References

01. Human energy requirements. Report of Joint FAO/WHO/UNU. Expert Consultation. FAO Food and Nutrition Technical Report Series No. 1. FAO, 2004.
02. Torun B. Energy requirements of children and adolescents. *Publ Health Nutr* 2005;8(7A):968–93.
03. FAO/WHO/UNU Expert Consultation. Energy and protein requirements. WHO Technical Report Series 724:1–206. Geneva: World Health Organization, 1985.
04. Hernández-Triana M. Fitness vs. Obesity in Cuban Children: Battling the Biases of Gender and Geography. *MEDICC Review*, Spring 2010;12(2):48.
05. Butte NF, Villalpando S, Wong WW et al. Higher total energy expenditure contributes to growth faltering in breast-fed infants living in rural Mexico. *J Nutr* 1993;123:1028–35.
06. Fjeld CR, Schoeller DA. Energy expenditure of malnourished children during catch-up growth. *Proc Nutr Soc* 1988;47:227–31.
07. Jiang Z, Yan Q, Su Y et al. Energy expenditure of Chinese infants in Guangdong Province, South China, determined with use of the doubly labelled water method. *Am J Clin Nutr* 1998;67:1256–64.
08. Butte NF. Energy requirements of infants. *Publ Health Nutr* 2005;8(7A):953–67.

The "Vitamins in My Life" Essay Competition

The year 2012 marked 100 years since Polish scientist Casimir Funk coined the term "vitamine" to describe bioactive substances essential for human and animal health. During this time, our understanding of the vital role of vitamins in nutrition has grown considerably.

¶ To mark the centenary, *Sight and Life* ran an extensive campaign to raise awareness of, and increase access to, the essential vitamins all people need to be well nourished. Part of this campaign was a call for people around the world to share with us their own story about the role vitamins play in their life and work.

¶ We are delighted in this edition of the magazine to share with you the four stories that touched us the most. Our congratulations go to the authors of the four contributions printed here, and our thanks to everyone who submitted their story to us. Each one was read with interest. These stories inspire us to continue our work in fighting the micronutrient deficiencies that affect the world's poor, and we are grateful to those who are making a difference in the communities where they live.

¶ With warmest wishes,

¶ The *Sight and Life* Team

First Place

Edwin Momanyi

"Do you monitor your daily diet?" "Not much, just as long as my satisfaction and that of my family is fulfilled." This was a response given by a neighboring widow to a doctor who was treating her undernourished child aged two and a half years. "Include enough vitamins in your diet," said the doctor.

That evening after discharge from hospital, the mother came direct to our resource center kiosk: "Please may I have some green vegetables as directed by the doctor." Her order included vitamin sources like dark green leafy vegetables, carrots, pumpkin, sweet potatoes, and cereals like sorghum and millet.

On her back was her crying baby with signs of being undernourished. When asked the condition of the baby, she said the child suffered from deficiency diseases due to lack of adequate vitamins. The signs like loss of appetite, general weakness, anemia, and sleeplessness confirmed to me that this was a case of malnutrition.

The doctor's advice was good I thought, not only for treating the child but also in considering the family's diet: "Include enough vitamins in your diet."

The mother managed to get enough sources of vitamins from our kiosk, except for a few from animal products and some fruits that we advised her to find at the nearby market. My concern to know what vitamins were became vital to me after the visit of that mother from the hospital. By this time I had my project which dwelt much on the production of vitamin A-rich foods. At the fields we deliberated on which vitamin A-rich foods we could plant. Thus, the most available, like carrots, paw paws, green vegetables, oranges, and other available fruits were accepted.

At the resource center, we provided produce from our garden and more people visited us. We gave them information about ways to grow and take care of seedlings of vitamin A-rich food sources, which in return, we gave them free as homework and made efforts to visit their fields to see the progress.

The continuation of growing vitamin A-rich foods had some impact on me and the people around and I felt it was my stepping stone to discover more about what vitamins are. Three years later, several health personnel had visited our fields to buy produce, although this was less than they needed, for they demanded more vitamin-rich foods. It was then that I had to expand my project to include more vitamin sources

TABLE 1: A sample of regular vitamin consumption per day.

Time	Food portion
Morning	Sliced banana, boiled egg, porridge, whole-grain bread, with fresh milk
Mid-morning	Pineapple slice, papaya, mango, melon, etc.
Lunch	Sweet potatoes with fresh milk; whole-grain food with heaped vegetables like spinach, cabbage, etc.; meat or fish.
Evening break	Juice made from citrus fruits; berries like cranberries, strawberries, raspberries; melon. Also taken with fortified foods like biscuits.
Supper	Chapati from whole-grain flour with beans, e.g., soybeans, with slices of fruits or juices; soup of liver.

than vitamin A. This decision led me to research vitamins and I found information materials from *Sight and Life* as a resource.

It was then that I discovered that vitamins were vital nutrients indispensable in performing various tasks within the human body in order to promote optimal health and prevent various diseases. Also, in conjunction with other nutrients, they help to break down proteins, thereby stabilizing the metabolism, enabling the growth of cell tissue and bones, and promoting a healthy immune system. Since each vitamin is vital to perform a specific task, a shortage in any one of them may lead to a host of health problems in the human body. After my research I then made efforts to include more vitamin sources through gardening and selling, also to include them in my daily diet. Some of the new sources like cucumbers and imported fruits were included. We also started rearing milk goats and keeping poultry as a way to include animal vitamin products in our resource center.

Some months later there was a change in our resource center, where the most vitamin-rich foods were found, and a great change also in my diet. I can recall my first meal full of vitamins. It included fruits and vegetables, where I ate five portions of a variety of fruit and vegetables. For example, in one day I ate a sliced banana with porridge made of millet flour,

then a snack of fresh milk. Later I ate a portion of pineapple or melon, then more than three heaped tablespoons of vegetables. By then I had made my personal timetable on vitamin intake, ensuring a balance of all vitamins in the diet, see **Table 1**. Our kiosk made it possible for me to have the vitamin sources readily available and mostly at cheaper prices. We even purchased a juice extractor machine and blender for the preparation of juices, which was good especially for old people and young children who had difficulty chewing vitamins. The vitamin kiosk, by then named OBOGIMA BWOMOREMI, had a beneficial impact on farmers' lives.

For instance:

1. We got different sources of vitamins easily;
2. There were profits to expand due to increased sales; and
3. We easily got seeds of some fruits that we planted and produced seedlings.

Good health results were the outcome, e.g., a healthy face, skin, hair, and good immune system. I consider the discovery of vitamins as a step to a good lifestyle.

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Second Place

D. M. Asela Dissanayake

Sharmila lived in our estate house. She was just seven years old, a thin pale girl. One day her mother took her to the estate dispensary, because she had infected wounds on both knees and her upper arm. I had also been at the dispensary as my daughter had flu and I needed to get some medicine for her. Sharmila cried and she did not allow anyone to do the wound dressing. The doctor and nurses of the dispensary tried to treat her. They asked Sharmila's mother how the wounds had happened. The mother told them that every evening Sharmila had knocked into something or had fallen inside or outside of the house. I saw the doctor examined her very carefully, her eyes, skin, and whole body.

Next day, the doctor came to our office to meet our welfare officer. He asked to arrange a meeting with crèche attendants, welfare officers, and the field officers of the estate. As a field officer of our tea estate, I belong to that team. At that meeting he told us about Sharmila's disease. He said that Sharmila and some of the estate children suffered from night blindness which was caused by vitamin A deficiency. Some of them suffered from other nutrition deficiency diseases. So he forced us to change their food habits. He taught us about the nutrition values of our day-to-day food. Those days most of the estate children had bread and sugar or honey for their breakfast. Their dinner was white rice with yam curry or dried fish curry. They never had vegetables, green leaves, or fruit for their day-to-day use.

One of our crèche attendants suggested introducing some recipes for children in the crèches and day care centers on the estate. She introduced a special soup that contained rice, pumpkin, some green leaves, tomato, and egg. Her next recipe was a snack prepared with wheat flour, rice powder, green gram powder, and a small amount of sugar. Rice, vegetables and green leaves with dhal or dried fish or egg were introduced to daily meals.

During the last four years our estate people have changed their food habits because health staff and teachers in the area are actively doing health education programs, exhibitions, etc. Managers of our estate provide free nutritious meals for infants and children in crèches and day care centers. Teachers check the mid-day meal of their students. Health department staff, such as public health inspectors and public health midwives, provide vitamin capsules and tablets for pregnant mothers, infants and small children.

Sharmila and her colleagues are now healthy, beautiful teenagers. This is the story of vitamins in their lives, and vitamins in my life.

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Third Place

O. V. Jinadasa

As a 75-year-old old retired government servant, I spend my time doing things like growing flowers, making small household things, etc.

One day, my daughter told me about the importance of growing vegetables rather than flowers. She gave me a copy of *Sight and Life* magazine. Some of the articles were difficult for me to understand. I asked my daughter to explain them to me. I got some knowledge about micronutrients. I had never heard about micronutrients in my school days. I now know about vitamins A, B group, C, D, E and K, iron, and calcium.

As a retired person I have limited money to spend on food. With my knowledge of micronutrient-rich food, I tried to cultivate some leaves and vegetables in my garden. I have only a little knowledge about agriculture and I am trying to gather knowledge from village farmers. We have limited space for gardening. My grandsons, granddaughters, and their colleagues help me. They use empty milk powder bags, paint cans, and polythene bags for our cultivating practice.

They like to grow plants and water, fertilize, and look after the plants. They asked "Why do you not enter an article about home gardening and agriculture in your *Sight and Life* magazine?" I think green leaves like swamp pea, cassava, and drumsticks are very helpful as vitamin resources. We grow pineapples, plantains, papayas, lemons, passion fruit, and limes. My grandsons and granddaughters very much like to eat fruit but some of them refused to eat vegetables and green leaves. I told them about vitamins in a story. The heroes of that story had been consuming green leaves, vegetables, fruits, grains, and small fish for their daily meals. Now they very much like to eat green leaves and vegetables in their daily meals.

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Fourth Place

Prince Akebo Abugri

Vitamins, micronutrients that are required by the body in small quantities, cannot be ignored because of their health benefits. Vitamins in the right quantities boost human immunity and prevent diseases in one's life. This benefit implies that anyone who is committed to the consumption of vitamins in the right proportion would cut down on the amount of money spent on healthcare, since the immune system would help prevent disease.

Despite these benefits of vitamins, many people have still not tapped into them because of ignorance and lack of knowledge of their benefits. Another factor, which I personally admit to, has to do with lifestyles that do not promote the consumption of vitamins through fruits and vegetables.

When I was growing up as a young child in a small town

in Ghana, the consumption of fruits after or in between meals was something that was not part of the family system. All we did was eat our staple food, which was mainly composed of carbohydrates, and then go to bed. We were not introduced as children to eating fruits and vegetables, though such foods were readily available in the neighborhood. We therefore grew up with the mindset that eating fruits and other vegetables was the preserve of the rich and since we were not as rich, eating it as part of our diet was out, even if we could afford it.

As I grew up and progressed steadily up the academic ladder, I began to realize the importance of fruits and vegetables and what they could do for me. Even with this knowledge as a science student in high school, I still did not make it a habit

to consume fruits and vegetables because of the mindset and lifestyle I had developed when I was growing up.

As a university student who was now studying nutrition as a course and studying deeper into the functions of vitamins, I began to make eating fruits and vegetables part of my diet since they were the cheapest and commonest source of vitamins. However, after my encounter with *Sight and Life* magazine at the Presbyterian Primary Health Care (PPHC) in Bolgatanga as a national service person, and joining the staff of PPHC to undertake nutrition education in schools and communities on the importance of micronutrients and where to find them, I then made a personal commitment to ensure that my body never lacked these important nutrients which are crucial for my survival. Consuming fruits and vegetables daily to meet my body's requirements became part of my life. I am now so used to it that I buy and store vegetables and fruits in the refrigerator for future use.

Not only do I consume fruits and vegetables as part of my diet but I also make sure that I buy products like cooking oil and bread flour that have been fortified with vitamins and minerals. This I am able to identify through the fortification logo on the packaging.

I currently also work with an NGO (non-governmental organization) that is made up of a network of primary healthcare providers in Tamale. As part of my work as a program manager in charge of public health and nutrition, I encourage mothers and all community members in villages to introduce fruits and vegetables in their diets, especially in that of children under five years, to reduce the rate of malnutrition in their households. The most important message I give them however, is that they should introduce children in the family to the consumption of fruits and vegetables

to make it a part of their lifestyle. This will enable them to live healthier lives and not later grow and struggle just as I did to make vitamin intake a part of their daily lives.

I have therefore realized that my commitment to vitamin intake through the consumption of fruits and vegetables has boosted my immune system and has protected me against sicknesses like malaria that easily beset me in the past. The frequency of going to the clinic to treat malaria has reduced significantly and I can say with confidence that I am healthy as a result of this lifestyle of making vitamin intake a daily priority.

Once again thanks to *Sight and Life* for the information you share and for stressing the need for vitamin intake over these years. Your emphasis on vitamins has changed my attitude towards the consumption of fruits and vegetables for good.

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A Day in the Life of Wilma B. Freire

Interview with Wilma B. Freire, PhD

Ministry of Public Health from Ecuador, on leave from the Universidad San Francisco de Quito

In this special issue of *Sight and Life* dedicated to Latin America, we speak with one of the continent's leading nutritionists on the nutrition requirements and challenges of the region.

Sight and Life (S&L): *Dr Freire, in a world of global communication and global markets, what are the defining characteristics of the nutrition space in Latin America?*

Wilma B. Freire (WBF): Latin American countries are facing a double burden of undernutrition and obesity. While undernutrition still affects a large proportion of small children in particular, obesity is affecting people throughout the life cycle. So the real challenge for Latin America is to tackle the two problems simultaneously, because they are interrelated.

In general, the levels of undernutrition are still high in the region, although we are observing significant differences within and among countries. On the other hand, the problem of obesity and overweight has emerged fairly recently but is growing rapidly, to the point that it is considered one of the major public health problems in the region.

In addition, micronutrient deficiencies affect people who are undernourished and who are overweight or obese. These deficiencies remain a significant problem in the region.

“Obesity and overweight is considered one of the major public health problems in the region”

S&L: *What progress towards improving nutrition in Latin America has been made as a result of the SUN (Scaling Up Nutrition) Movement in recent years?*

WBF: Three Latin American countries are involved in the SUN initiative: Guatemala, El Salvador, and Peru. There is no question that SUN represents an excellent strategy, which has allowed these countries to undertake activities to reduce malnutrition in a coordinated fashion and that will unquestionably result in improvements in the nutritional status of children. Nevertheless, we cannot ignore the fact that many other countries are strongly committed to confront malnutrition and obesity. Examples include Mexico, Brazil, and Chile.

S&L: *What are the key topics on the agendas of Latin American nutrition scientists and nutrition policy-makers at present? How do you see this developing post 2015?*

WBF: There is still major concern with undernutrition, especially because it affects vulnerable populations, particularly women and small children. Nevertheless, among nutrition scientists it is clear that we cannot ignore the rapid growth of overweight and obesity. Policy-makers for the most part are very much aware of undernutrition and its effects as well as some of the steps that can be implemented. The challenge for the scientific community is to communicate to them that overweight and obesity represents a growing problem and should be addressed at the same time as undernutrition, especially because both have their origins in pregnancy and the early years of life.

S&L: *In what ways can nutritionists help to shape public health policy in Latin America?*

WBF: First, it is very important that well-trained nutritionists play an active role in helping decision-makers address overweight and obesity, because at present, it is still less visible at the policy-making level than undernutrition. Second, nutrition-



Wilma B. Freire is one of Latin America's leading nutritionists

ists can help shape policies related to specific deficiencies by bringing them to the attention of decision-makers. Third, nutritionists can play a significant role in bringing together professionals from different disciplines and sectors; this is necessary because of the complexity of nutrition problems.

S&L: *What is the role of women specifically in delivering improved nutrition in Latin America?*

WBF: Women are playing an increasingly important role in the work force in Latin America. In this context, they must be able not only to fulfill traditional roles as mothers and caregivers, but also to enjoy workers' rights, especially to incomes that allow them to acquire sufficient quantities of nutritious foods. In order to deliver improved nutrition, women must also be able to employ culturally appropriate childbirth practices that ensure that babies have adequate iron stores and to initiate breastfeeding within the first hour after childbirth. They must also be guaranteed the right to practice exclusive breastfeeding for the first six months and adequate complementary breastfeeding for the following 18 months.

“Women must also be guaranteed the right to practice exclusive breastfeeding for the first six months”

S&L: *What attracted you to a career as a nutritionist?*

WBF: I have always believed in equal rights and equal opportunities. In Latin America, there are many forms of inequality, and I have always thought that nutritionists can apply their knowledge and skills to all people regardless of sex, race, ethnicity, social class, or age. I have seen that they can accomplish this by participating in the implementation of nutrition programs that enhance people's well-being.

S&L: *What have you enjoyed most about your career to date, and what have you been most proud of?*

WBF: I have been able to work for government and non-governmental organizations as well as international agencies. In particular, my experience in PAHO gave me the marvelous opportunity to work with highly committed and well-trained professionals throughout the region as well as with dedicated local counterparts. I have learned more from them than I have given.

What I have enjoyed most and am most proud of, though, has been the opportunity to teach university students and see the results in their developing careers. They are the next generation of nutritionists and health professionals, and I am confident they will make important contributions.

S&L: *If you could change one thing about your career in retrospect, what would it be?*

WBF: The truth is that I would not change anything in my career. I have been very fortunate because I have been able to formulate professional objectives and to reach them. The only caveat I would add is that I have always thought that I will never have enough time to learn as much as I would like to in my field.

S&L: *What leadership qualities do you admire in others?*

WBF: To me, it is very important that leaders have the capability to transmit their knowledge in a way that is both useful and enjoyable. Another key element is the ability to make difficult decisions in difficult moments.

S&L: *Have you ever had a defining experience – whether positive or negative – that has fundamentally shaped your approach to leadership?*

WBF: Early in my career, I had the opportunity to work with indigenous communities and other poor people in Ecuador. I learned from them that their knowledge can contribute to planning and implementing effective solutions to nutrition problems when there are adequate resources to do so. Unfortunately, I have seen on other occasions and in other places that local knowledge is often ignored. I think that leadership involves understanding that poverty, poor health, and malnutrition are related to inadequate opportunities to use local knowledge appropriately, rather than lack of knowledge.

S&L: *If you could develop your own leadership training program for public health professionals, what would it look like?*

WBF: I would include three basic components in order to develop public nutrition leadership. First, I am a strong believer in providing science-based technical tools in statistics, epidemiology, and public health. A second component would provide skills-based training in communication, social marketing, and intercultural skills. Finally, I am convinced that all public health professionals must have solid training in impact evaluation tools, because I believe that all programs must undergo rigorous evaluation.

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“The knowledge of indigenous communities can help in the planning and implementation of solutions to nutrition problems”

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S&L: *Latin America has used multisectoral, integrative approaches to deal with a variety of public health issues. In your experience, what are the opportunities and challenges of the multisectoral approach, and what is the best way of stimulating commitment among different stakeholders?*

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WBF: Governments that are truly committed to those kinds of approaches will provide adequate human and financial resources and will develop the capacity to incorporate the contributions of a variety of stakeholders. It is important to work at the political level with local technical resources whenever possible. I am convinced that in almost all cases in Latin America, those technical resources are available and are important for optimizing local participation and ensuring the highest possible level of commitment from a wide range of stakeholders. Conversely, when opportunities for local participation at different levels are not taken advantage of, the likelihood for program success is extremely limited.

S&L: *What are your hopes for the SUN Movement in Latin America going forward?*

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WBF: Going back to my previous answer, this involves taking advantage of local resources and the participation of a variety of stakeholders at the country level.

S&L: *In what ways can organizations such as Sight and Life contribute to improving nutrition in Latin America?*

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WBF: *Sight and Life* can contribute by continuing to provide scientific information and evidence, by sharing successful experiences in other parts of the world, and by providing technical support to address significant problems in the countries of the region. The provision of policy documents and action reports to professionals in the region is also an important contribution to improving nutrition.

S&L: *What are the key dates in your diary for the coming months, and why are they important?*

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WBF: Within the next few months, the national survey on health and nutrition, ENSANUT-ECUADOR, will be released. This sur-

vey includes the second national nutrition survey (the first was conducted 27 years ago) and the first study of the determinants of chronic diseases. The survey, which I designed and directed, began more than two years ago, and when the results are made available, we will have contributed to a greatly enhanced understanding of the health and nutrition situation in Ecuador. I hope that its results will contribute to the evaluation of ongoing programs in order to respond to the problems of malnutrition that affect large segments of the population. I also think the results will be of interest to people in other countries of the region and in other parts of the world.

S&L: *What are your interests outside work?*

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WBF: I enjoy visiting different parts of Ecuador, which despite its small size, is extremely diverse. We have a coastal region and the headwaters of the Amazon, divided by our portion of the Andes Mountains. And of course, Galapagos is part of Ecuador. I am still discovering places I have never visited!

S&L: *Thank you very much, Wilma.*

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Wilma B. Freire was interviewed by Jonathan Steffen

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Sight and Life Interview

Stanisław Berger: A Living Legend

Professor Stanisław Berger was the recipient of a Living Legend Award at the 19th International Congress on Nutrition in 2009. He looks back on a career as a nutrition scientist that spans over 70 years and reaches back to his compatriot Casimir Funk, who coined the term “vitamine” in 1912 and in whose Warsaw laboratory Professor Berger worked as a young man.

Sight and Life (S&L): Professor Berger, you have dedicated your professional life to the subject of nutrition. What made you choose this discipline as the main focus of your career?

Stanisław Berger (SB): It was due to many calamities in my difficult life – the first being the bombardment and destruction of my house in Warsaw at the outbreak of the Second World War in September 1939. I became homeless for many years thereafter. Two aspects of what was to follow gave my life its definitive direction.

The first was that, having lost my home, I worked on farms belonging to friends of my family. I attended at this time the only agricultural high school that existed in Poland during the Nazi occupation, namely Czernichów near Kraków. My favorite subjects (at the time, and ever since) were biology and chemistry. I always had my chemistry textbook with me in my rucksack during the war.

The second stems from my experience as a soldier in the Polish Army. After almost 2,000 kilometers of marching and fighting our way into Germany that took the Polish forces all the way to Dresden, I was severely wounded in a terrible massacre. I was partially paralyzed and taken from the battlefield as a prisoner of war. I was put in various hospitals and kept without food and water for three or four days (this was done to save my life, on account of the gunshot wound I had received). I was to escape death on three more occasions after this, but this was the first and most memorable occasion.

From a relatively early age, therefore, I had a deep knowledge of food production, and also of intense hunger. This com-

ination of experiences motivated me to embark on a career as a nutritionist, and human nutrition science became my lifelong passion.

“My knowledge of food production, and also of intense hunger, motivated me to embark on a career as a nutritionist”

S&L: You became an employee of the Department of Hygiene Nutrition of the National Institute of Hygiene in Warsaw in 1950. How has the world’s concept of public hygiene and public health changed in the past 60 years?

SB: This is a big question, and it should be addressed to the relevant policy-makers and decision-makers in Poland’s government, public health institutions and medical universities. My work at the Department of Nutrition in the State Institute of Hygiene (PZH) (now part of NIPH) lasted only seven years (from 1950 to 1957), after which I went to the Graduate School of Nutrition at Cornell University, USA, as the first Rockefeller Fellow from Poland after the Second World War. On returning from the USA, I became a professor at the Warsaw University of Life Sciences (WULS) [Szkola Główna Gospodarstwa Wiejskiego (SGGW)], where I started working in 1953.

In my personal opinion, to eliminate – or at least diminish – hunger, we need to unite agriculture with medicine. This applies to hidden hunger too, and likewise to dietary-related health conditions such as obesity.

S&L: The Warsaw University of Life Sciences is Poland’s largest agricultural university, and dates back to 1816. You became a Professor of Agriculture there in 1976, having worked for the United Nations Food and Agriculture Organization (FAO) from 1967 to 1970, and you are currently honorary chairman of the Committee of Nutrition Sciences at the Polish Academy of



Professor Stanislaw Berger in the academic robes of the Warsaw University of Life Sciences (WULS) [Szkoła Główna Gospodarstwa Wiejskiego (SGGW)]

Sciences. What, in your view, has been Poland's major contribution to agriculture and nutrition studies in the past half-century?

SB: Poland's major contribution has been in recreating, and also establishing from new, various academic and research institutions in the field of nutrition science – for example, the Food and Nutrition Institute, which is supported by FAO. My work at Warsaw University of Life Sciences is part of this effort. It has involved the creation and leadership of the first Institute of Human Nutrition and eventually – unique in Poland, and perhaps in all of Central Europe – of a Faculty of Human Nutrition and Consumer Sciences that offers residential, extramural, and evening courses all the way up to post-doctoral level, as well as running widely respected research projects.

“Poland's major contribution has been in recreating, and also establishing from new, various academic and research institutions in the field of nutrition science”

S&L: *You co-edited the book “Nutrition Sciences for Human Health”, which was published in 1988. How do you regard the developments that have taken place in nutritional science since that date?*

SB: In terms of national food and nutrition policy, most of the ideas outlined in the chapter “Human Nutrition Science in the Food Chain” (pp. 1–8) have been adopted in Poland. Perhaps certain aspects of this book should be updated now – for instance, in relation to ecology, economic and social change, and advances in laboratory equipment. It is imperative, however, that we continue to invest heavily in research in this area and also in related educational programs.

S&L: *What, in your opinion, is the significance of the Scaling Up Nutrition (SUN) movement?*

SB: My opinion about SUN is very positive, because food is useless if not consumed. Nutrition is therefore rightly becoming a focal point in the SUN Movement's strategy for 2012–2015, and I agree that “together we are achieving what no one of us can do alone.” However, we have to consider possible cooperation with existing bodies (e.g. the UN, the EU, regional and national institutions, and many societies and organizations). Perhaps in the SUN Movement we need “officers” for managing nutrition

activity. My suggestion is therefore to develop appropriate projects or graduate programs within the discipline of nutrition (e.g. throphology, nutribiology).

I believe that human nutrition science must play the key role in the food chain. The right to life will be an empty slogan if we do not secure the right to food and healthy nutrition based on unbiased scientific evidence. Let us hope that human nutrition science will help us to solve – today, and in years to come – many complex aspects of the food chain to the benefit of the world's population.

S&L: *You have been awarded the Commander's Cross with Star of the Order of Polonia Restituta, and the Gold Medal of Honor NOT (the Polish Federation of Engineering Associations). What do these honors mean to you?*

SB: The question should really be put to the people who have nominated me for these awards! For my part, I see them as recognition of over 70 years of hard work in the service of nutrition, both in my native Poland and abroad.

S&L: *Looking back on your career, what would you do differently if you had the opportunity to live your life again?*

SB: I would not change anything about my difficult life, except that it would have been nice to be able to devote more time to my family, and also to leisure activities.

S&L: *As a young man, you studied under Casimir Funk, who developed the concept of “vitamines” in 1912. What are your recollections of Casimir Funk, and how would you assess his influence on nutritional science?*

SB: When Funk returned to Warsaw (1923–1927) I had just been born, but his spirit and ideas helped me when I was working in his laboratory at the State Institute of Hygiene (PZH) – Nutrition Unit. From 1950–1957 I conducted many experiments there, most of them dedicated to vitamin science (especially vitamin A and carotenoids) and nutrition.

It is a pity that despite being nominated, Funk did not receive the Nobel Prize in recognition of his pioneering work in vitamin science. In his Nobel Prize Lecture of December 11, 1929, Sir Frederick Gowland Hopkins stated that “Funk had received not too much, but too little credit for his vitamins work as a whole.” I am working now on Kazimierz Funk's activity as a “traveling scientist in vitaminology” (his career took him to Bern, Paris, Berlin, London, New York, Warsaw, Paris, and New York again). In Poland, he is regarded not only as a vitamin scientist but also as nutrition scientist on the basis of his excellent knowledge of biochemistry.

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“In Poland, Casimir Funk is regarded as a nutrition scientist”

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S&L: *You have had a very full and distinguished career, Professor Berger. When you look back on everything that you have done and experienced, what advice would you give to a young person wanting to study nutrition science today?*

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SB: I would repeat some of the things I said when receiving a Living Legend Award at the 19th International Congress Nutrition, which was held in Bangkok in 2009. They all begin with a *p*:

- > **First:** Be **Passionate** about your activity, because with full engagement you may expect good results;
- > **Second:** Be **Patient** about obtaining results, which may come in the short term but may also come only in the long term;

> **Third:** Be ready to **Publish** or **Patent** your achievements in well-regarded scientific journals, for if you do not, they will perish;

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> **Fourth:** Expect that you will have a **Piece of luck** in your chosen field of activity;

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> **Fifth:** Be ready to **Promote** your co-workers and successors, otherwise your success will vanish; and

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> **Sixth:** Be **Precise** in speaking and writing.

S&L: *Professor Berger, thank you very much.*

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Professor Stanislaw Berger was interviewed by Jonathan Steffen

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First Announcement Oxygen Club of California 2014 World Congress, University of California, Davis, May 7–10, 2014 Davis, CA, USA

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The Oxygen Club of California is pleased to announce the upcoming OCC 2014 World Congress to be held at the University of California Davis Convention Center from May 7 to May 10, 2014.

The OCC 2014 conference focuses on Nutrition and Redox Biology in Development and Health. The program covers cutting-edge science with an internationally recognized group of outstanding speakers and includes the following sessions:

- > Polyphenols and Flavonoids: From Metabolism to Dietary Guidelines
- > The first 1,000 Days: From Metabolic Signal to Societal Impact
- > Redox Signaling and Systems Biology in Health
- > Vitamin E in Translational Medicine

- > Round Table Discussion: Micronutrients, Signaling, and Health
- > Round Table Discussion: Central Role of Mitochondria in Health Systems

Abstract deadline: March 30, 2014

The scientific program is available at the OCC 2014 website www.oxyclubcalifornia.org/OCC2014/index.php

You are welcome to contact us for any further information, and we hope that you will join us in this outstanding meeting.

On behalf of the organizing committee,
Dr. Maret Traber
President
Oxygen Club of California

Public Health Specialists Call for Road Map to Support Healthy Aging Through Improved Vitamin Status

Jonathan Steffen

Jonathan Steffen Ltd, Windsor,
United Kingdom

Leading public health specialists met at the University Medical Center Groningen, the Netherlands, on April 4, 2013, to discuss nutritional approaches to support healthy aging and in particular the economic benefits of optimal micronutrient intake over the life course.

As part of its European Innovation Partnership on Active and Healthy Ageing, the European Union aims to facilitate the addition of “two more healthy years” to people’s lives by 2020. The workshop held on April 4, entitled Healthy Aging and the Economic Impact of Micronutrient Intake, sought to address the question whether and how the provision of essential micronutrients (vitamins and minerals) might contribute to this ambitious goal.

The day-long workshop, organized by the University Medical Center Groningen, a renowned center of expertise in healthy aging, and DSM Nutritional Products (Basel, Switzerland) brought together leading international experts in the subject. The workshop was held at the newly founded European Research Institute for the Biology of Aging (ERIBA). The purpose was to share information and approaches to assess the impact on long-term health and healthcare outcomes of inadequate micronutrient intake via the diet.

According to the World Health Organization (WHO), “in almost every country, the proportion of people aged over 60 years

“The aging of the world’s population challenges society to adapt”

is growing faster than any other age group, as a result of both longer life expectancy and declining fertility rates. This population aging can be seen as a success story for public health policies and for socioeconomic development, but it also challenges society to adapt, in order to maximize the health and functional capacity of older people.”

From 2000 until 2050, WHO’s website on the topic continues, “the world’s population aged 60 and over will more than triple from 600 million to 2 billion.” Good health is key if older people are to remain independent and to play a part in family life, at work and in business and community life. Lifelong health promotion, with a clear emphasis on the fundamental role of nutrition and essential micronutrients to reduce risk of chronic disease, can prevent or delay the onset of non-communicable diseases, such as heart disease, stroke, and cancer. WHO’s website states that “these services are best delivered through comprehensive primary care.” Nutrition is globally recognized as being an important factor in optimal health throughout the life course.

The workshop Healthy Aging and the Economic Impact of Micronutrients covered a wide range of topics, from the economic value of food fortification for general consumption, through the special needs of hospital patients and people living in institu-



The world's population is growing on an unprecedented scale. Supporting healthy aging will become an increasingly important challenge for nutritionists and policy-makers worldwide.

tions to the economic value of medical nutrition (diets specially fortified for patients in hospital).

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“A significant scientific and medical consensus exists as to the importance of an appropriate level of micronutrient intake throughout the life course”

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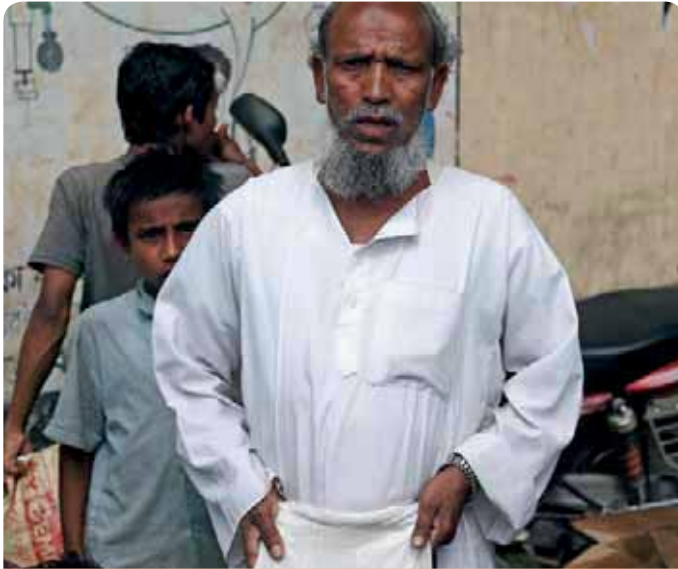
Workshop conclusions

The workshop came to the following important conclusions and calls for action to initiate the appropriate changes:

1. Nutrition is a complex topic in itself, and so are its fields of application. Nevertheless, a significant scientific and medical consensus exists as to the importance of an appropriate level of micronutrient intake throughout the life course to support growth, foster health, and prevent the onset of disease. Moreover, recent changes in lifestyle and eating patterns, along with increasing dependency on pre-cooked and processed foods,

require more attention to nutrition, as nutrition is a key factor in determining human health. Appropriate micronutrient intake (vitamins and minerals) – as part of a balanced diet and in combination with a healthy lifestyle – encourages health and well-being. The presence of micronutrient deficiencies in the developing world is well established, but a growing body of evidence indicates that micronutrient deficiencies also exist in the developed world, and that these negatively affect the health, well-being, and economic status of significant sections of society. The term “hidden hunger” is commonly used in this context, as these deficiencies are often ignored and underappreciated despite being a global issue of rising importance with devastating consequences for individuals, communities, and national economies alike.

2. Micronutrient requirements vary with the various stages of life. They have the highest impact during the first 1,000 days with consequences throughout an individual's life. Later in life, they have to be adjusted to the specific micronutrient requirements of the elderly and those living in particular settings such as hospitals and institutions. Other demographic groups besides the very young and the very old are also at risk of micronutrient deficiencies and inadequate intake, however. These are:



The body's nutritional requirements vary as it ages. The provision of age-appropriate nutrition will grow in significance in the coming years.

pregnant and breastfeeding women, adolescent girls, critically ill hospital patients, the institutionalized, and low-resource communities.

3. Micronutrient deficiencies and inadequate micronutrient intake compared to recommendations can have serious health consequences for individuals; they also have a wider impact on societies, economies, and healthcare and welfare systems. The consensus concerning the value of appropriate micronutrient intake is based on a robust body of evidence and a number of powerful nutritional and economic models. It is, however, critical to develop models that address the complexities of micronutrient interventions.

4. The extensive scientific knowledge currently available needs to be translated into cost-effective, practical public health solutions. These may include fortification and/or supplementation. Specific delivery mechanisms should be assessed on a case-by-case basis.

5. The health and economic benefits of fortification or supplementation with certain micronutrients – e.g., vitamin A (to reduce infant mortality), iodine (to reduce goiter), vitamin D (primarily against rickets), and folic acid (primarily to reduce neural tube defects) – is clear. Many countries of the world already have in place mandatory fortification programs involving these micronutrients. The absence of such programs in Europe (for folic acid and vitamin D), is an unacceptable gap in our public health system and should be scrutinized in the light of the overwhelming evidence of the proven benefits of fortification/supplementa-

tion programs involving these micronutrients. While the health and economic benefits of fortification or supplementation with vitamin D and folic acid are clear, more research is required in the context of other micronutrients.

A road map to promote micronutrient interventions

During a plenary discussion about a road map to increase the recognition of the importance of micronutrient interventions, participants agreed that the above points should receive the urgent attention of the public health and nutrition community, policy-makers, patient organizations, health insurers, and other stakeholders, and that next steps should be taken to give a healthy diet a higher priority.

The conclusions will be consolidated, and – through a multi-stakeholder initiative led by the University Medical Center Groningen – a road map is to be drawn up towards the implementation of fortification and supplementation programs in Europe and other developed regions. This will involve micronutrients whose benefits are already demonstrably clear. At the same time, further efforts should be undertaken to assess the potential health and economic benefits of fortification and supplementation programs involving other micronutrients.

Translating existing evidence into public health actions

Micronutrient fortification and supplementation programs in the developing world should be scaled up to national level with the necessary support from donors. It is essential to translate existing evidence into public health actions. This will require public-private partnerships involving governments, academia, civil society, and the private sector – four groups that have a key role in providing the necessary nutritional solutions.

The organization of the workshop Healthy Ageing and the Economic Impact of Micronutrient Intake was made possible by DSM, Danone, Nestlé, Friesland Campina, and Healthy Aging Network Northern Netherlands.

The organizers of the workshop agreed to initiate next steps.

For more information, please contact:

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International Congress

Hidden Hunger, from Assessment to Solutions

Monika Potter

Sight and Life, Basel, Switzerland

The first international congress addressing the widespread problem of hidden hunger took place from March 6–9, 2013, at the University of Hohenheim in Stuttgart, Germany. The four-day event enabled policy-makers, academics, politicians and business leaders to come together and share their knowledge and experiences in order to increase awareness of, and discuss solutions to, the hidden hunger problem.

Creating awareness of hidden hunger

The first part of the congress was dedicated to the causes of hidden hunger and the difficulties that arise when addressing this problem. Hidden hunger “refers to the deficiencies of micronutrients (vitamins and minerals) in individuals or populations as a consequence of poor dietary quality, which negatively impacts on health, cognition, function, survival, and economic development.”¹ Hidden hunger is a problem affecting not only people in developing countries but also those in developed nations, a point that was highlighted during various presentations. For instance, Manfred Eggersdorfer of DSM Nutritional Products presented evidence showing that intake of folic acid and vitamin D in Europe is low. Suboptimal intakes do not necessarily result in clinical deficiencies, but they can lead to impaired health with no obvious clinical symptoms. The problem is hidden from view, thus the term “hidden hunger.”

“Hidden hunger is a problem affecting not only people in developing countries but also those in developed nations”

The complexities of hidden hunger

Hidden hunger results from consuming a low-quality diet. During the congress, it was highlighted that many factors can influence diet quality, especially complex indirect factors such as food markets and socioeconomic status. Food prices play a pivotal role in the development of hidden hunger. It is commonly assumed

that if a person consumes more calories, then that person will also consume more nutrients. However, Adam Drewnowski of the University of Washington’s Nutritional Sciences Program demonstrated that in developed countries, energy-dense foods cost less and nutrient-rich foods cost more per calorie. Therefore a healthy, balanced diet with adequate levels of micro- and macronutrients is less accessible to people of lower socioeconomic status, amplifying the risk of hidden hunger within this group. This problem can be addressed by promoting behavior change, providing subsidies to at-risk groups, and/or through food fortification.

“A healthy, balanced diet with adequate levels of micro- and macronutrients is less accessible to people of lower socioeconomic status”

It is currently unknown whether or not this connection is also true for developing countries, as data to assess these factors is not available. Nevertheless, it becomes evident that hidden hunger is a complex issue which is influenced by many factors on many levels. Programs developed and used to reduce hidden hunger should therefore take these influencing factors into account.

Whether or not the production of bioenergy intensifies the problem of hidden hunger was discussed by Harald Grethe of the University of Hohenheim, Institute of Agricultural Policy and Agricultural Markets. Dr Grethe explained that the production of bioenergy can, on the one hand, create opportunities in terms of income and access to energy, and can lead to market development and improved infrastructure. On the other hand however, the production of bioenergy from biomass is likely to increase malnutrition when it competes with food or feed, and does not provide direct income opportunities to those most at risk of nutritional deficiencies. It was argued during the congress that in such scenarios, complementary policies are required to ensure that markets work properly and to limit potential negative outcomes.

Although our understanding of hidden hunger and its solutions is improving, there are still many uncertainties that hinder the development of guidelines for addressing this problem. It was important to highlight these during the congress in order to emphasize areas for action. Patrick Webb of Tufts University’s

Friedman School of Nutrition and Policy stressed that invisibility is a major barrier. Many countries lack quality data regarding micronutrient status or intake. This is compounded by the fact that not all micronutrient deficiencies can be measured. The magnitude of the problem, therefore, remains concealed until it becomes measurable.

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“Hidden hunger is a complex issue that is influenced by many factors on many levels”

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Furthermore, there is usually no data available in countries or regions experiencing ongoing conflicts and unrest, although the populations of these regions are usually the worst-affected by micronutrient deficiencies. Moreover, within heterogeneous countries, micronutrient status can vary greatly from region to region, a fact not reflected in most country data, which is not regionally differentiated. Thus, a true picture of the issue does not become apparent.

In addition to geographical variation, there is the fact of seasonal variations in hidden hunger. For instance, it has been understood for some time now that the prevalence of child wasting correlates to growing seasons and harvest patterns. Furthermore, nutrient-pharmacological interactions are becoming increasingly evident. This problem might be exaggerated among people who are malnourished. Only a few studies – including folic acid interventions in malaria-endemic areas – have been conducted, and these have shown that the data is still inconclusive. By looking at hidden hunger in a holistic manner, however, we are able to see its complexity.

Solutions to hidden hunger

Various solutions to hidden hunger were discussed throughout the congress. Some of the main solutions highlighted were single and multiple micronutrient supplementations. These methods of supplementation can have many benefits, such as improving recipients' resistance to disease. However, these can be offset by possible adverse effects as well as complications such as infections, both of which can reduce compliance. In Indonesia, for example, an intervention study demonstrated that a multimicronutrient powder had the unintended effect of changing the color, taste, and smell of the food to which it was added, resulting in poor compliance. Such approaches therefore require counseling in order to make them sustainable.

Judy Mclean of the The Micronutrient Project, University of British Columbia, stressed the necessity of formative research to help improve study and program success. As an example, she cited the results of formative research from Rwanda and Zambia

that have helped to identify possible difficulties and create culturally adequate communication pathways.

A further approach to combatting hidden hunger is fortification, carried out on either a voluntary or mandated basis. Zulfiqar Bhutta of the Aga Khan University in Pakistan pointed out that, generally speaking, the technical elements of large-scale fortification are not barriers in themselves – often the true barriers to success are the enforcement, cost implications, and compliance associated with fortification. A mass-fortification (i.e., fortification of foods widely consumed by the general population) approach regarding folic acid is described separately as a highlight of the congress.

Voluntary fortification, which is driven by manufacturers, was discussed by Lindsay Allen of the University of California, Department of Nutrition, as an approach which can successfully increase the intake of nutrients that are hard to supply through mass fortification. However, this approach could potentially deceive or mislead consumers, therefore, it is advisable that voluntary fortification should be regulated by local authorities. At the moment, there exists no systematic overview about how to address this issue.

Elien Rouw of the Academy of Breastfeeding Medicine, Well Baby Clinic argued that hidden hunger can also be addressed by improving gender equity. Suboptimal breastfeeding leads to 1.4 million child deaths each year. Breastfeeding rates are low across East Asia and are decreasing in the Middle East and North Africa. Various reasons account for this trend, including limited social support. Breastfeeding may cause great personal disadvantages to mothers but provides huge benefits to children. Social situations therefore need to change before women can make the decision to breastfeed on a personal – not economic – basis. Unfortunately, methods for achieving this change are not clear cut. Approaches need to differ depending on the region and culture in question, and the economic value of breastfeeding needs to be communicated in order to improve important factors such as maternity-leave programs.

Finally, food-based approaches can improve the status of hidden hunger. Brian Thompson of the Food and Agriculture Organization of the United Nations (FAO) observed that the focus of much research in the past has been limited to micronutrients. While this focus has shifted in the recent past, with food-based solutions now being addressed, one of the main solutions to hidden hunger still focuses exclusively on micronutrient powders and supplements. It is necessary to broaden this focus to concentrate on food – by improving the diversity of diets, for instance. Ellen Mühlhoff, FAO, Nutrition Education and Consumer Awareness Group, Nutrition and Consumer Protection Division, showed that a food-based approach is highly accepted by mothers. It was explained that local foods can help to improve the intake of many micronutrients. While this may not fully alleviate

hidden hunger, it should be considered as a positive complementary strategy. It is therefore suggested that food-based approaches and fortification should be considered in tandem.

Although the widespread notion is that diversity leads to better nutrition, Matin Qaim of the Department of Agricultural Economics and Rural Development, University of Goettingen, argued that this is not always true. For example, agricultural households with access to a wide range of crops do not automatically have improved iron, calcium, zinc, and vitamin A intake. For these families, farming is often just an income pathway – they produce these foods to sell, but may not consume them at all. It is therefore essential to understand not only the availability of foods, but also their consumption patterns and the mitigating factors involved in the decisions people make about food consumption.

Discussion and conclusion

It is evident that there are many difficulties involved in addressing the complex problem of hidden hunger. Parul Christian of the Johns Hopkins Bloomberg School of Public Health, Center for Human Nutrition, Department of International Health, stressed that it is important to recognize hidden hunger as an intergenerational issue, and that it therefore cannot be solved by focusing on any one age group in isolation. Moreover, it is not a problem that can be solved solely by improving nutrition – non-food interventions have also shown great results.

For example, Zulfiqa Bhutta showed that stunting at 0–6 months of age is largely influenced by maternal nutrition. Social interventions such as raising the age at which a woman's first pregnancy occurs, can lead to better pregnancy outcomes. Consequently, all social, agricultural, economic, and nutritional factors need to be addressed in order to successfully improve the situation.

Marie Ruel of the International Food Policy Research Institute pointed out that there is a lack of evidence of the sustainability of most platforms currently delivering micronutrient interventions in developing countries. These include social protection, and agriculture-based and health sector programs. It is essential to determine the sustainability of these interventions in order to develop adequate program guidelines, which are necessary for clarity – there are currently too many overlapping commitments in the field, many of which have no distinct way of addressing the problem of hidden hunger.

There remain many barriers to reducing the problem of hidden hunger directly. Nevertheless, the preliminary goal of this congress – increased awareness of hidden hunger – was reached. The exchange of information and resulting discussions have provided an opportunity to create a road map to addressing the problem of the hidden hunger directly. This first congress on hidden hunger can therefore be considered a good start.

Highlight

Sight and Life Symposium: Investing in healthy children by increasing folic acid intake

Folic acid not only has the potential to reduce neural tube defects (NTDs), but can also reduce the occurrence of oral cleft and the incidence of stroke, and improve the mortality of people with an increased cardiovascular disease (CVD) risk. Furthermore, there is evidence that it might have a positive impact on depressive disorders and autism.

Despite these positive outcomes, many countries still resist mandating folic acid fortification of flour due to several concerns, such as the possibility of exceeding the tolerable upper intake level, the masking of vitamin B₁₂, increased cancer risks, and changing the properties of drugs. Additional concerns, such as “impure foods” and a possible loss of consumers stalled a mandatory policy for introducing folic acid fortification in New Zealand, which was about to begin mass fortification together with Australia. It is important to discuss the myths and beliefs concerning folic acid since they are a significant hurdle concerning the introduction of fortification. Data from countries that have introduced mandatory fortification demonstrates that the above-discussed concerns are in fact not supported by scientific literature. Furthermore, data from intervention trials as well as meta-analyses evaluating folic acid supplements support the fact that these fears are unfounded.

The necessity of folic acid fortification as well as the prevalence of hidden hunger was pointed out by Oleksandra Kalandyak of the Dzherelo Children's Rehabilitation Centre, Ukraine, in her description of children's homes in the Ukraine that cater to many children with NTDs. Many of the children living in these homes are completely bedridden, and some suffer from severe malnutrition. The prevalence of NTDs in the Ukraine is two to four times higher than in the United States. Scientific evidence alone is not always sufficient for the introduction of crucial public health measures, as demonstrated by the folic acid case; advocacy and communication are at least as important.

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References

01. *Sight and Life* website, Hidden Hunger www.sightandlife.org/fields-of-work/hidden-hunger.html

The Show Must Go On

Carotenoids Research Interaction Group (CARIG) Conference, Boston, April 19, 2013

Noel W. Solomons Center for Studies of Sensory Impairment, Aging and Metabolism (CeSSIAM), Guatemala City, Guatemala

Friday, April 19, in Boston, Massachusetts, USA was a day of unprecedented disruption. The pursuit of suspects in the bombing of the Boston Marathon obliged all residents and visitors in the metropolitan Boston area to remain in place indoors. Taxis and public transportation were suspended. The CARIG Conference and the VARIG/CARIG receptions were scheduled for the Westin Boston Waterfront Hotel. The affiliates who had arrived at the hotel by the previous evening were free to get to the event venues. Ironically, those in other hotels and those residents in the Boston area were precluded from attending. This included Elizabeth Johnson of the Jean Mayer Human Nutrition Research Center on Aging (HNRC-A) in Boston, who was slated to deliver the annual James Allen Olson Perspectives on Carotenoids Memorial Lecture, as well as her associate at the HNRC-A, Rohini Vishwanathan, for one of the thematic talks of the afternoon. The speakers for the remaining three thematic presentations were available in the hotel, and along with 40 or so dedicated affiliates in the audience, they took the conference forth with a truncated program. Loredana Quadro of Rutgers University and Zeina Jouni of Mead Johnson Nutrition were the chairpersons.

Advocacy for biofortification

The first presentation was given by Sherry Tanumihardjo, University of Wisconsin at Madison on the topic of Combating Vitamin A Deficiency through Agricultural Approaches: It takes Communication. It was a self-described message to the younger attendees for advocacy on behalf of biofortification. Dr Tanumihardjo distinguished between provitamin A enrichment of edible plants through hybridization, as with sweet potatoes, cassava, and maize, as opposed to Golden Rice, which is a genetically modified organism (GMO). The latter is rejected out of hand in some quarters; the nation of Zambia, for instance, rejected food assistance because the foodstuffs were GMO. Her central thesis is that frank and open communication is a major part of the solution and should include a wide range of stakeholders:

plant breeders, molecular biologists, food technologists, human nutritionists, extension workers, food product developers, economists, and communication experts. Biofortified foods are useful as they reach low-income sectors where large amounts of staple foods are consumed. Among the ideas is high provitamin A maize, which is a staple for porridge in large areas of the African continent. Sherry narrated a positive experience in Zambia where consultation, mobilization, and communication took place at every level from government ministries to the study village in an investigation funded by Harvest Plus. As a testimony to the success and promise of biofortified foods, she presented the example of the orange-fleshed sweet potato, which is on the market in Uganda to improve vitamin A nutrition.

Eye health

The second presentation was by Lewis Rubin, Texas Tech University Health Science Center, El Paso, Texas. It was entitled It's not only Adult-Onset Macular Degeneration: Retinal Xanthophylls in Diabetic Retinopathy and Retinopathy of Prematurity. The pathophysiology of adult-onset macular degeneration recognizes an increasing role for two xanthophyllic carotenoids, lutein and zeaxanthin, in the macula (fovea) of the retina of the eye. The fovea forms, even in preterm babies; under the appropriate conditions, retinal vasoproliferative diseases affect distinct vascular beds. This is the condition known as retinopathy of prematurity, in which oxidative stress from the high-oxygen environment, used to counteract the pulmonary issues of the immature lung, stimulate vascular proliferation. This process can, of course, lead to blindness. Of interest to the narrative is that lutein is the predominant pigment in the developing eye.

Another important cause of visual impairment and blindness is diabetic retinopathy, which affects 40–45% of all diabetic patients. The damage is related to ischemia of a pan-ocular nature. Dr Rubin pointed out that stress-induced vascular proliferation has three progressive stages: **1.** non-proliferative; **2.** ischemic; and **3.** vasoproliferative. There has been some investigation of whether or not lutein affects diabetic retinopathy. Experimental models show that lutein suppresses oxidative stress in streptozotocin-induced diabetic mouse, which could be an inferential indicator of a potentially protective role for this xanthophyll in human retinopathies associated with diabetes.



Orange-fleshed sweet potatoes improve vitamin A status.

A bird's-eye view

Matthew Toomey of the Washington University School of Medicine, St. Louis, concluded the program with a presentation on the topic of Fine-tuning of Avian Color Vision by Selective Apo-Carotenoid Metabolism. It covered the lessons that can be learned in carotenoid biology from avian color vision. The story begins with the implications of carotenoids for the color of the plumage of birds. The reds, oranges, and yellows of the feathers from flamingos to woodpeckers to song birds are dependent on dietary carotenoids. These in turn are important in mutual recognition and mating rituals. But the integumentary pigmentation would be of little utility if the birds themselves did not have acute color vision.

Birds, like fish, have eyes on the opposite sides of their heads and do not have binocular vision, as do mammals. For rapine birds who hunt other birds and mammals, to song birds that live on flying insects, vision is essential in the avian world for securing food in the hunt. For localization of prey, moreover, spatial discrimination in three dimensions is vital. Dr Toomey used basic and new knowledge about the mechanisms in the retina of common poultry and song birds, such as zebra and house finches, to elucidate the role of carotenoid biology in avian vision.

Evolution has provided oil droplets in the apices of the rods in the central portions of avian retina. These selectively concentrate one of three xanthophyllic pigments: zeaxanthin, (sensitive to green) and two more unusual molecules, astaxanthin (sensitive to red) and galloxanthin, a carotenol (sensitive to blue). The rods, with specific and separate positioning, permit separation of colors in the objects of vision, and hence improve 3-D spatial location. Interestingly, dietary lutein and zeaxanthin sup-

plementation increase concentrations of galloxanthin. However, neither supplementation of these common xanthophylls – nor direct supplementation of astaxanthin – is capable of altering the retinal concentrations of the latter.

CARIG/VARIG social reception

Most of the student participants in the poster contest were able to make it to the venue of the CARIG/VARIG social reception. The winners of the best research prize were Elizabeth Spiegler, a graduate student in the Food Science Department of Rutgers University with the poster, Does beta-carotene-9',10'-oxygenase (CMO2) generate retinoic acid during embryonic development? and Carlo dela Sena, graduate research associate in the Department of Human Nutrition of Ohio State University with the poster, Purified recombinant human beta-carotene 15,15'-oxygenase cleaves beta-apocarotenals and lycopene.

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Partnership for More Sustainable Packaging Inspires Innovation Challenge

Meredith A. Perry

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Improving Nutrition – Improving Lives

Kakuma Refugee Camp in Kenya hosts between 50,000 and 70,000 refugees in a remote, semi-arid region that, while safe from the violence of their home countries, is poorly situated for agriculture, economic opportunity, and infrastructure. The limited resources within the camp and extreme poverty of the refugees mean that many are victims of hidden hunger – a chronic deficiency of vital vitamins and minerals. To combat both overt and hidden hunger, Kakuma residents depend on international aid and the provision of nutritional supplements to meet their needs.

To provide the essential micronutrients to those living in Kakuma, as well as other refugee camps, slums, and disaster relief zones, and to make countries and communities more resilient to disasters, DSM, *Sight and Life*, and the World Food Programme (WFP) formed a partnership to improve access to micronutrients – particularly iodine, vitamin A, B-vitamins, and iron – to ensure improved health and proper growth and development of the most vulnerable in these settings. Among other activities, the partnership distributes single-dose packages containing a powder of essential vitamins and minerals (MixMe™) that can easily be mixed into food just before consumption. The micronutrients do not alter the taste or appearance of the food and can be efficiently delivered at scale. As part of the partnership, millions of MixMe™ sachets are distributed annually to several million of the 90 million beneficiaries of the WFP in 73 countries.

In Kakuma, *Sight and Life* and the WFP committed not only to distributing the multiple micronutrient powders (MNPs) but also to studying barriers to their use. The resultant report, *A Qualitative Study Examining Low Micronutrient Powder Uptake at Kakuma Refugee Camp*, prepared by Stephen Kodish and Joel Gitelsohn, both of the Johns Hopkins Bloomberg School of Public Health, identified opportunities to advance the success of the MNP distribution program. A recommendation was made “to improve upon the existing ... box and sachet material.”¹ The current MixMe™ sachets comprise layers of a composite aluminum, PET, and polyethylene foil and are designed to protect the MNP from degradation under difficult environmental conditions, including temperature, light, and humidity. Unfortunately, the same packaging attributes that protect the MNPs mean the sachets cannot be recycled, repurposed, burned, biodegraded, or composted.

“We care about the impact the packaging has on the environment”

As part of the global movement to implement sustainable, environmentally sensitive business practices, *Sight and Life* recognized that the current MNP packaging was undesirable. Klaus Kraemer, *Sight and Life*'s Director, says, “As the innovators of MixMe™, it is our responsibility to address any of the possible negative consequences that any element of the MNP could have, which, in this case, is the collateral waste that they generate. We care not only about the content of the sachets, but also about



Micronutrient powders greatly enhance the nutritional value of complementary food.

the impact the packaging has on the environment.” To that end, *Sight and Life* approached Scientists Without Borders, a public-private partnership led by the New York Academy of Sciences, and proposed staging an open innovation competition for novel or alternative packaging and delivery approaches that might also contribute to the scale-up of MNP interventions by being more appealing from a design or delivery perspective.

The Sackler Institute for Nutrition Science, also a program of the New York Academy of Sciences, joined Scientists Without Borders and *Sight and Life* in developing and disseminating the challenge due to the Institute’s interest in the connection between nutritional quality and environmental sustainability. Environmental sustainability has been identified as an important gap in research in the recently launched A Global Research Agenda for Nutrition Science, which maintains that generating novel ideas is the first step in developing more sustainable nutrition research and implementation.²

An injection of innovation

To that end, *Sight and Life*, Scientists Without Borders, and The Sackler Institute hosted an open innovation challenge over 90 days in Summer 2012 with prizes totaling US\$25,000. The challenge sought concepts for more sustainable and effective approaches for delivering MNPs that also satisfied cost-per-unit

requirements and that would protect the MNPs’ integrity under harsh conditions. The challenge yielded 36 submissions from 16 countries, with one third of the submissions coming from the developing world.

The winning solutions were chosen by an independent expert panel including Joel Gittelsohn of the Kakuma study; Saskia De Pee of the World Food Programme; Nina Goodrich of GreenBlue and the Sustainable Packaging Coalition; Lynnette Neufeld of the Micronutrient Initiative; and Arnold Timmer of UNICEF.

Three winners were selected to share the prize, and their ideas combined proven packaging techniques with new, innovative concepts.

- 1. First Place** (receiving US\$12,500): Jose Tarquino of Valley Stream, NY, for “New Double Sack (DS) economical packaging for ‘Essential Powdered Nutrition Supplements.’”
- 2. Second Place** (receiving US\$9,000): Ilya Mir of Sacramento, CA, and Ellery West of Crescent City, CA, for “Repurposing Existing Condiment Packaging.”
- 3. Third Place** (receiving US\$3,500): Mehrdad Keshmiri of Port Moody, Canada, for “Use of chitosan setting solution for sustainable and effective packaging for essential powdered nutrient supplements to combat malnutrition.”



Kakuma Refugee Camp in Kenya

Each of the solutions addressed the need to create MNP packaging that is both effective in protecting the MNP and sustainable as the distribution is scaled-up. Judges noted that the first-place solution – a hardy, biodegradable-film inner sack containing the micronutrients, with a paper outer sack – was well considered and viable for implementation, and that similar materials have been successfully used in other packaging contexts. The second-place solution recommended the inverse: a robust recyclable outer container protecting biodegradable inner sachets. The third-place solution, which requires more testing, suggested the innovative use of a chitosan shell material that would serve as a sustainable protective barrier but that would also be fully biodegradable.

“The identification of viable solutions demonstrates the success of the challenge”

The identification of viable solutions demonstrates the success of the challenge and illustrates the partners’ commitment to utilizing innovative approaches in order to identify and accelerate solutions to global development challenges. By using the Scientists Without Borders open innovation model to connect the unique insights of external problem-solvers with the needs and expertise of leaders in the field of MNPs, such as *Sight and Life* and the Sackler Institute, organizations can develop and

promote more sustainable and effective interventions that have the potential to fight malnutrition and reduce environmental impact in the world’s lowest-resource settings.

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References

01. Kodish S, Gittelsohn J A. Qualitative Study Examining Low Micronutrient Powder (MNP) Uptake at Kakuma Refugee Camp. Johns Hopkins Department of International Health, Bloomberg School of Public Health. 2011; June; 42.
02. The Sackler Institute for Nutrition Science. A Global Research Agenda for Nutrition Science. Outcome of a collaborative process between academic and non-profit researchers and the World Health Organization. New York, 2013;13 pages. Internet: www.nyas.org/whatwedo/nutrition/agenda.

Report from Latin America

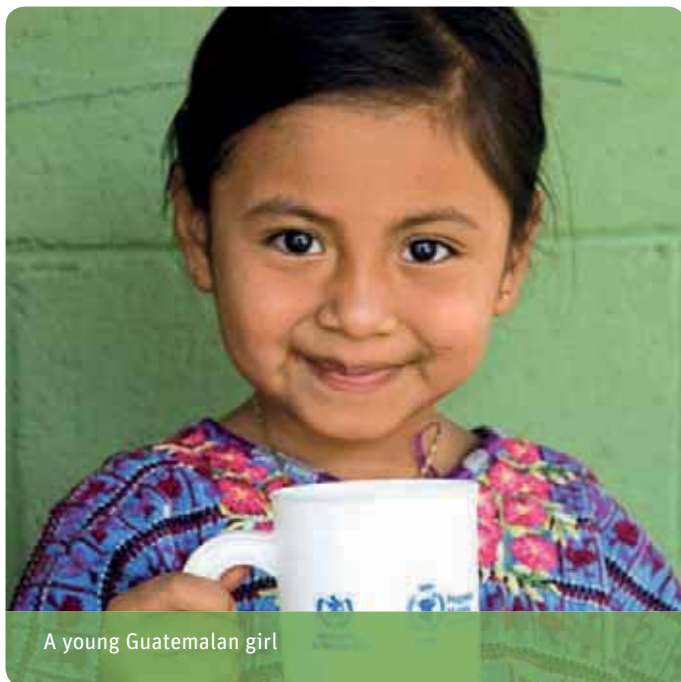
WFP facilitates South-South cooperation in Latin America

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A young Guatemalan girl

In recent years, South-South cooperation (SSC) has become an important tool for promoting development. It is a highly valid instrument for sharing information, technology, and capabilities. This is particularly true in Latin America and the Caribbean (LAC), where SSC has gained prominence on many governmental platforms.¹

Cooperation activities have mostly focused on sharing experiences related to industry, technology, and infrastructure. Social policy issues, particularly those related to hunger eradica-

tion and disaster risk management, have featured less visibly on the SSC agenda. The region, however, has accumulated a vast amount of experience, practices, and knowledge pertaining to food and nutritional programs. These best practices can be transferred efficiently among countries, based on common denominators such as historical background, language, middle-income emerging economies, and regional integration agreements.²

“WFP’s goal in the region is to support national governments to improve food and nutrition security”

WFP’s overarching goal in the region is to support national governments to improve food and nutrition security and reduce the impact of emerging crises, natural disasters, and climate change among vulnerable populations. Countries in the region with emerging economies and consolidated social protection schemes provide opportunities to facilitate South-South cooperation and knowledge-sharing on food and nutrition security themes. For example, in recent years Brazil has demonstrated innovative approaches to inclusive development in areas such as food security and social protection, developing a model that is highly influential in South-South cooperation.⁵

Fighting hunger and undernutrition through South-South cooperation

Despite the region’s progress in its fight against hunger, chronic undernutrition (stunting) and micronutrient deficiencies (especially anemia) still constitute critical challenges, mainly due to poor access to food, lack of food availability, insufficient consumption, and/or inadequate feeding practices, as well as lack of access to healthcare and a healthy environment.³

Stunting among children under five is significantly more severe among rural and indigenous populations, with rates that are more than double of those found in urban populations. Disparities between and within countries are notable. Stunting prevalence ranges from 5.6% in Costa Rica to 48% Guatemala. In the latter, stunting prevalence reaches 70% in some areas,

especially in those where indigenous peoples are concentrated.⁴ Stunting undermines the development of individuals as well as of communities. South-South cooperation has strong potential as a tool for addressing this and other priority issues in LAC, due to its grounding in solidarity and consensus.

“South-South cooperation has been useful in supporting progress towards the MDGs”

South-South cooperation has been useful in supporting progress towards the Millennium Development Goals (MDGs) and the discussions on the global goals and partnerships for the Post-2015 Development Agenda envisage a more central role for South-South cooperation moving forward.

The World Food Programme (WFP) has a long history of working with the region’s governments through the implementation of technical assistance projects as well as development projects in the area of food and nutrition security. In this context, WFP has engaged in facilitation of South-South cooperation, helping national governments to set priorities, routing cooperation requests, and identifying partnerships for development. Through SSC, WFP seeks to facilitate dialogue on food security and nutritional policies, transfer of cost-effective practices, learning through exchanges of experiences and knowledge, and identification of financing opportunities. This objective is achieved through partnerships with governments, research centers, and regional organizations.

WFP, with regional headquarters in Panama City and 12 country offices in the region, promotes and facilitates South-South cooperation around three key thematic areas: strengthening programs for eradicating hunger and undernutrition, supporting governments in their school feeding programs, and strengthening capacity to prevent and respond to disasters.

South-South cooperation for Scaling Up Nutrition

Through its Programme for South-South cooperation, Chile has been present in confronting the region’s challenges on hunger. This Program is managed through the Agency for International Cooperation (Agencia de Cooperación Internacional [AGCI]). AGCI has worked in liaison with WFP to provide technical assistance in support of country-led processes to scale up nutrition in the 1,000 days window of opportunity, a broad international initiative to improve early nutrition. This movement targets pregnant and lactating women, as well as children under the age of two years. Most recently the Chilean Fund against Poverty and Hunger, a South-South mechanism that is financed by the Government of Chile, has supported nutritional initiatives in

countries such as Honduras and Guatemala through technical assistance and training. WFP Regional Office in Panama works in close coordination with AGCI and the Chilean Fund against Poverty and Hunger in support of national nutrition programs like the ongoing Guatemalan initiative “Hambre Cero.”⁶

Chilean technical cooperation has also played an important role in inserting nutrition into institutional and regulatory frameworks. AGCI and WFP made contributions to the Republic of Paraguay for the consolidation of the National Institute of Food and Nutrition (INAN) as a formal part of the structure of the Ministry of Health (MINSAL) and its direct impact on health policy and the National Strategy for the Reduction of Poverty and Inequality. This institutionalization led to the formulation and adoption of the Law on Prevention, Care and Control of Malnutrition in Paraguay.

On policy, research, and advocacy, South-South cooperation has also a role to play. The experience with the study the “Cost of Hunger: Social and Economic Impact of Child Undernutrition in Latin America and the Caribbean,” conducted in 2007 has been an inclusive exercise in which technicians and policy-makers from different countries participated. The joint study led by WFP and the Economic Commission for Latin America and the Caribbean (ECLAC) promoted the exchange of experiences and transfer of knowledge through workshops, seminars, and virtual platforms. The methodology, with some adaptations, allowed for the replication of the study in some countries of Africa. The study has been used as an advocacy tool to demand further investment in nutritional programs.

South-South cooperation in school feeding and social safety-net programs

WFP also has a strong partnership with the Government of Brazil. The WFP Center of Excellence against Hunger in Brazil is born of this partnership. The Center constitutes an innovative mechanism for WFP that aims to respond to governments’ requests to strengthen national capacities and stimulate global knowledge on sustainable school feeding programs. It aims to support governments in the design, management, and expansion of nationally owned, nutritious, sustainable school feeding programs, simultaneously promoting food and nutrition security. The Center leverages the expertise of WFP and Brazil while promoting the sharing of lessons learned around the world in terms of sustainable school feeding models and practices. Delegations from countries such as Bangladesh, Mali, Burundi, Mozambique, Senegal, Malawi, Niger, Rwanda, Honduras, and El Salvador have visited the Center.

In addition, the IV Latin-America & Caribbean School Feeding Seminar in 2011 was hosted by the Government of Mexico, La-Rae (Latin-American School Feeding Network), WFP, and FAO with participation from 19 countries of the region. This seminar rep-

resented a clear space for networking and establishing contacts among technicians and policy-makers related to school feeding.

WFP has also partnered with Mexico, which represents a strong contributor of experiences with regard to food security and nutrition interventions through South-South collaboration. Mexico has provided countries of the region with advice on the formulation and implementation of public policies and social safety-net programs. Their experience in running relatively large social protection programs with a nutrition component, like Oportunidades, has been relevant for several countries in the region.⁷ At the request of Central American countries, high-level technical workshops were jointly organized by WFP and the Secretariat of Social Development (SEDESOL) to exchange experiences in social protection, particularly as related to conditional cash transfers and their impact on the nutritional status of vulnerable populations, using the Mexican experience as a model. Participants from Colombia and Haiti also benefited from these exchanges.

Most of the region's governments are investing in social protection programs, although the quality and reach of programs vary considerably between and within countries. Therefore, each country has a potential lesson to offer through South-South collaboration, as well as experiences that can be replicable at local and national levels.

With the support of WFP, Panama and Costa Rica have shared experiences in fortification of rice through a horizontal cooperation process. A technical mission composed of key officials from the main governmental institutions of Panama, as well as Panamanian entrepreneurs from the rice sector, was carried out in Costa Rica. The exchange of experiences provided guidance in terms of policies and strategies for rice fortification, checks of compliance with regulations, and techniques for determining micronutrient content.

“South-South cooperation is essentially inspired by solidarity”

South-South cooperation and capacity development

South-South cooperation for combating hunger and undernutrition in LAC should be centered on improving generation of information, developing human resources, mobilizing community leadership, and strengthening governmental leadership, with the firm support of agencies from the United Nations (UN) System, such as the World Food Programme, and other organizations.

South-South cooperation is essentially inspired by solidarity, horizontality, a desire to learn from one another, mutual respect, brotherhood, and collaboration that attempts to reduce differ-

ences. There is less emphasis on the development of theoretical models of cooperation and more on sharing what has been learned. In the case of hunger and undernutrition, WFP and other agencies of the UN System can contribute by establishing links between countries and institutions, documenting practices, and contributing to measure results with a view to generating the necessary evidence to develop and implement strategies and tools that allow countries in LAC to effectively address undernutrition.

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References

01. South-South and Triangular Cooperation in the United Nations System. Available from: ssc.undp.org/content/dam/ssc/documents/Evaluation%20Reports/JIU%20Evaluation%202011.pdf Cited: July 17, 2013
02. Informe de la Cooperación Sur-Sur en Iberoamérica 2012 – Segib. Available from: segib.org/cooperacion/files/2012/10/Informe-Sur-Sur-2012.pdf Cited: July 17, 2013
03. PAHO, Malnutrition in Infants and Young Children in Latin America and the Caribbean; Achieving the Millennium Development Goals. Washington, DC. PAHO 2008. Available from: [www2.paho.org/hq/dmdocuments/2009/MalnutritionEng\[1\].pdf](http://www2.paho.org/hq/dmdocuments/2009/MalnutritionEng[1].pdf) Cited: July 17, 2013
04. WHO, Integrated WHO Nutrition Global Databases. Available from: <http://apps.who.int/nutrition/landscape/report.aspx?iso=GT&rid=161&template=nutrition&goButton=Go> Cited: July 15, 2013
05. A new global partnership: eradicate poverty and transform economies through sustainable development. The Report of the High-Level Panel of Eminent Persons on the Post-2015 Development Agenda, 2013. Available from: www.post2015hlp.org/featured/high-level-panel-releases-recommendations-for-worlds-next-development-agenda/ Cited: July 15, 2013
06. Pacto Hambre Cero: Retos para Guatemala. Gobierno de Guatemala (Zero Hunger Pact: Challenges for Guatemala. Government of Guatemala) Available from: www.mineduc.gob.gt/portal/contenido/menu_lateral/programas/seminario/docs13/PACTO%20HAMBRE%20CERO.pdf Cited: July 20, 2013
07. Oportunidades. Secretaría de Desarrollo Social (SEDESOL). Gobierno de México (Opportunities. Secretariat for Social Development [SEDESOL]. Government of Mexico). Available from: www.oportunidades.gob.mx/Portal/wb/Web/conoce_oportunidades Cited: July 15, 2013

Report from Guatemala

Mounting and Adaptation of a Fluorescent Rapid-Assay Device (iCHECK® FLUORO) for Vitamin A in Sugar and Biological Fluids

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Scientific Director of CeSSIAM

Sight and Life arranged to provide an iCHECK® FLUORO rapid assessment unit and a supply of iEX® extraction vials to the Center for Studies of Sensory Impairment, Aging and Nutrition, to strengthen their capacity-building program for exchange students and for analyzing the situation of vitamin A in contemporary Guatemala.

Through the efforts of the late Guatemalan biochemist, Guillermo Arroyave, a method for fortification of granulated table sugar with vitamin A was devised in the 1970s and subsequently adopted as a mandated public health program for Guatemala and the other countries of the Central America Isthmus. A rapid assay method would allow for convenient spot-checking on samples of sugar in the area to monitor the quality of compliance. Breast milk vitamin A has been advanced as a non-invasive and convenient indicator of population status. A user-friendly format for measuring milk vitamin A would contribute to the application of this biomarker.

A Canadian and Guatemalan student joined forces to adapt the application of iCHECK® FLUORO to the circumstances of Guatemala under the supervision of two senior professionals. It is with pleasure that we combine our institutional forces to share a report of these preliminary inquiries in measurement. It was originally presented in the periodical of CeSSIAM in Guatemala, and we reproduce it here for the wider, worldwide readership of *Sight and Life* magazine.

Noel W. Solomons

Guatemala City

Klaus Kraemer

Basel, Switzerland

Guatemala was once a country with a high prevalence of low circulating retinol levels, that is < 20 µg/dL. In the 1964–1965 Central American Survey of the International Committee for Nutrition in National Defense (ICNND), 26% of children under five years of age had retinol values below the cut-off criterion. This led to the mobilization of efforts at the Institute of Nutrition of Central America and Panama (INCAP) by Dr Guillermo Arroyave



Noel Solomons (right) with Klaus Kraemer outside *Sight and Life*'s office in Kaiseraugst, Switzerland

for a method to add vitamin A to granulated table sugar in the national supply.¹ As part of the evaluation of the efficacy of fortified sugar, breast milk from lactating consumers was assayed for changes in vitamin A concentration.² Both of these studies in the 1970s depended on tedious and laborious extraction and colorimetric methods in the laboratory.

“Adaptation to the conditions of a field laboratory”

Advances in analytical technology

Analytical technology has advanced over the last three decades to allow for the emergence of rapid methods to assay food substances and biological fluids for their content of vitamin A. Prof. Florian Schweigert at the University of Potsdam in Germany conducted analytical chemistry, which led to a simplified system of solvents for extracting lipid-soluble compounds in a sealed vial. This has been manufactured and marketed by the BioAnalyt Company in Teltow, Germany, as the iEX® MILA vials. This extraction technology has been combined with a series of portable, compact battery-operated devices for the analysis of nutrients in foods or biological fluids in a rapid manner and at the site of the collection, if warranted. One of these is the iCHECK® FLUORO (BioAnalyt), which uses fluorescence as the analytic signal for quantifying retinol or retinyl esters. The developers in Potsdam collaborated with counterparts in Guatemala, to demonstrate the application of the iCHECK® FLUORO system with the iEX® MILA vials.³

The present mission was to take the systems from a sophisticated university laboratory and adapt them to the makeshift setting of a simulated field laboratory, while improvising the mixing and measuring equipment with items that can be purchased in pharmacies and supermarkets in low-income countries. In this exercise, we sought to prepare cow milk and heavy cream (as surrogates for human milk) and granulated sugar for rapid vitamin A analysis. A diverse array of plastic syringes was made for measurement instead of volumetric flasks or graduated cylinders. Clear plastic sandwich or storage bags were used for mixing, shaking, and dilution. Spoons were substituted for spatulas to transfer sugar, and medicine cups were tared on the balance to weigh out sugar samples. The formal equipment, aside from the iCHECK® device, was a digital balance (supplied by the manufacturer) and a Vortex mixer.

With respect to cow milk, 0.5 mL samples were delivered into iEX® vials and, after agitation and resedimentation, the fluorescence measurements of the clear phase containing the extracted vitamin A were made in the well of the device. After four readings, a digital value in µg/L was given. Although the commercial milk's label specified 900 µg/L, the average of 622 µg/L

obtained by rapid assay was credible, given the notorious errors in dairy labeling of enriched nutrients. The coefficients of variation (CV) were 15% and 2.1%; interobserver agreement of average measures was excellent. The concentration of vitamin A in heavy cream was so high that the direct readings of 0.5 mL delivery exceeded the linear area of the device. When diluted to a suitable concentration, the average vitamin A concentration was 3,536 µg/L.

For the preparation of solutions of table sugar, we used 20 mL plastic syringes, previously plugged with silicon to make them into a water-tight vessel; 4 g specimens of an unknown sugar sample were weighed to a 0.01 g precision on a digital balance (DigiWeigh, Chino, CA, USA). When filled to the syringe volume, a 20% (w/v) solution was obtained. For this dilution, a correction factor of 200 applied to the digital reading converts it into the concentration of vitamin A in the original sugar, expressed as mg/kg. Samples of different sugars were obtained from different brands, and were mixed in plastic bags to assure homogeneity. Nevertheless, CVs within sample for the observers ranged from 0.1–4.2%.

Lessons and conclusions

This exercise in adapting the iCHECK® FLUORO system to a setting in a low-income country provided some lessons and conclusions. Interobserver agreement for overall averages is high. The CVs within and between observers were high, especially for sugar. Assuring consistent values requires multiple replicate preparations, and this raises the costs, as the iEX® MILA vials are a relatively expensive commodity.

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References

1. Arroyave G, Aguilar JR, Flores M et al. Evaluation of sugar fortification with vitamin A at the national level. Washington, DC: Pan American Health Organization, (PAHO Scientific Publication no. 384), 1979.
2. Arroyave G, Beghin I, Flores M et al. Effects of the intake of sugar fortified with retinol, by the pregnant women and infant whose diet is usually low in vitamin A. Study of the mother and child. *Arch Latinoam Nutr* 1974;24:485–512.
3. Schweigert F, Frey S, Mothes R, Dary O, Juarez P, Lascano V. A new test kit's potential for the rapid analysis of vitamin A in human and cow milk. *Sight and Life Magazine* 2011; 3:18–22.

Report from Indonesia

The Ninth South East Asian Nutrition Leadership Program

Lina Rospita

SEAMEO RECFON, Jakarta, Indonesia



Delegates from different countries in Southeast Asia discussing a point during a group session

The ninth South East Asian Nutrition Leadership Program (SEANLP) was held on November 5–9, 2012, in Jakarta, Indonesia, with 22 participants from six countries (Indonesia, Malaysia, Myanmar, Cambodia, Thailand, and the Philippines). This year SEANLP was attended by participants from universities, the Ministry of Health, hospitals, national health and nutrition centers, and SEAMEO RECFON. The SEANLP is part of the European Nutrition Leadership Program (ENLP) network. The SEANLP is organized by the South East Asian Ministry of Education Organization (SEAMEO) Regional Centre for Food and Nutrition (RCFN) at the University of Indonesia, formerly known as SEAMEO Tropical Medicine and Public Health Network (TROPMED) Regional Center for Community Nutrition (RCCN). The main objective of

the SEANLP is to empower nutritionists at postgraduate level working in government bodies, research institutes, and academia by providing competencies in effective leadership skills like team-building and communication skills. The SEANLP also aims to provide a forum for networking among nutritionists in the region.

SEANLP is also receiving continuous support from the advisors Dr Corazon V. C. Barba, the former Director of Food and Nutrition Research Institute in the Philippines, and Prof. Khor Geok Lin, formerly from the Department of Nutrition and Health Sciences, University Putra Malaysia, and currently affiliated with the Department of Nutrition and Dietetics, School of Pharmacy and Health Sciences, Faculty of Medicine and Health, International Medical University, Malaysia. SEANLP also benefits greatly from the attendance of other speakers who share their experiences in leadership: Dr Wayah S. Wirotto as the leadership motivator, Dr Dini Latief (former Director Family Health and Research WHO/SEARO), Marina Pergiawati from Unilever Indonesia, Dr Anuraj Shankar from Harvard School of Public Health, Sonia Blaney from UNICEF, and Giulia Baldi from World Food Programme. The SEANLP Alumni and SEAMEO RECFON staff were also facilitators during the program.

The program was opened by the Director of Higher Education/Rector of University of Indonesia, Prof. Djoko Santoso, and Director of SEAMEO RECFON, Dr Ratna Sitompul. For the outbound and team-building activities, the participants traveled to Lido, Sukabumi, West Java. For the class session, the topics were program objectives and expectation; leadership concept and framework; leading self; leading people; leading change; lead the business/organization; and managing is leadership. For nutrition, topics included: Millennium Development Goal (MDG): Will SEA meet their goals?; the role of nutritionists in achieving the MDGs; SEANLP's role in developing and communicating "vision in nutrition." Besides lecture and discussion sessions, the participants also worked on case studies, debate competitions, and games. Every day the participants reviewed what they had learned the previous day. An after-dinner speech was given by invited speakers every night after the program. In addition, the participants produced a newsletter reporting their daily activities, which was distributed at breakfast each morning. On the last day of the program, the participants selected their Presi-



A rafting competition brought unexpected challenges – and a lot of fun.

dents of the ninth SEANLP batch. They also presented their future plan as follow-up activities as a group of SEANLP. In the closing ceremony, the participants performed a cabaret show. An award was given to participants who creatively and actively contributed during the five-day program. The committee also presented the participants' evaluation of the program.

The first SEANLP was held in October 2002 with 28 participants from six countries. Up to now, there are 189 SEANLP alumni from 11 countries working at universities, the Ministries of Health or Public Health, research institutes, and others. The SEANLP Alumni Association shares information through mailing lists and social media networks. Other activities include joint writing among the alumni. Considering that the majority of SEANLP alumni are leaders in nutrition in the region and have important and high positions in government or universities, the future of the SEANLP will be directed to creating a "hub" for activities in research, program implementation, and policy formulation aimed at enhancing human nutrition in the South East Asian region.

Acknowledgements

The ninth SEANLP was jointly funded by SEAMEO RECFON, International Nutrition Foundation (INF), and *Sight and Life*. We are very grateful for additional funding support from the funding agency and look forward to continued support for the next SEANLP.

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Report from Mexico

Barriers to the Promotion of Healthy Infant Growth at Primary Healthcare in Nutrition Transition Contexts

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Key messages

- > Barriers to promoting optimal infant and young child feeding and growth monitoring span the individual, organizational, community, and cultural realms
- > Medical and nursing school curricula should include education on breastfeeding, complementary feeding, and the use of WHO Growth Standards
- > Programs that also address organizational and community cultural factors are more likely to be implemented appropriately

Introduction

In Latin America and other nutritional transition contexts, there is a pressing need for feasible interventions at primary healthcare (PHC) level for the promotion of healthy infant growth, defined as the effective promotion of exclusive breastfeeding and adequate complementary feeding and growth monitoring. This is necessary to ensure “appropriate” linear growth and weight gain during the first two years of life, thus preventing simultaneously undernutrition, obesity, and chronic diseases. This article

identifies the barriers faced by providers to the promotion of healthy infant growth at PHC, which needs to be considered in the design of such interventions.

Methods

Using a mixed methods approach,¹ quantitative ($n=56$) and qualitative ($n=36$) information from providers (physician and nurses) and mothers/caregivers was analyzed from a database of Mexico’s main human development program, Oportunidades.^a Data triangulation was accomplished using different quantitative instruments (provider interviews, exit interviews with mothers/caregivers, observation of patient/caregiver-provider interaction) and qualitative instruments (in-depth interviews and group discussions). Barriers to promoting healthy infant growth were organized by levels on the socioecological model.²

Results

Providers do not routinely assess practices or provide counseling on breastfeeding (Table 1) and complementary feeding (Table 2). The advice given by providers was inconsistent with WHO recommendations.³ Mothers introduce liquids into the child’s diet very early (from 15 days old), as well as tidbits of food (around three months of age), the latter often encouraged by healthcare providers. According to providers, there is also an early introduction of foods such as instant soups, junk food, and sweetened beverages that jeopardize complementary feeding.

Regarding growth monitoring, they do not use the three anthropometric indicators (height/age, weight/age, and weight/height) stated by norm. They focus more on weight than height, and on single measurements rather than the growth trajectory of the child with respect to both weight and height.

Barriers to promoting healthy infant growth

Figure 1 presents a summary of the main barriers to promoting healthy growth in PHC.

^aOportunidades is a conditional cash transfer program that provides cash as long as beneficiaries comply with requirements to use preventive healthcare and attend health and nutrition education sessions.

TABLE 1: Assessment of breastfeeding practices and recommendations during consultations. Healthcare providers' survey.

Practices	Healthcare providers (physicians and nurses) n = 56*
Reason for visit:	
Healthy children	35.7
Sick children	51.8
Nutrition monitoring or undernutrition	5.4
Others	7.1
Duration of the visit in minutes (mean ± SD)	18.4 ± 8.39
Breastfeeding assessment (Infant ≤ 6 mo; n = 19 IYC 6–24 mo; n = 37)	
Breastfeeding status:	
Breastfeeding (any type) ≤ 24 mo	30.4
Breastfeeding (any type) ≤ 6 mo	52.6
Asked if child was breastfeeding:	
Children ≤ 24 mo	19.6
Infants ≤ 6 mo	42.0
IYC 6–24 mo	8.1
Asked about type of liquids consumed:	
Children ≤ 24 mo	16.1
Infants ≤ 6 mo	21.0
Asked about type of food consumed:	
Children ≤ 24 mo	35.7
Infants ≤ 6 mo	10.5
Advised to caregivers about breastfeeding (≤ 24 mo):	
Advised about breastfeeding during first days of life (colostrum's nutrient content and defense properties)	30.4
Advised about continuing breastfeeding	34.0
Advised about exclusive breastfeeding until 6 mo	12.5
Advised about when to initiate complementary feeding	1.8
Advised about breastfeeding techniques	23.5
Advised to caregivers about breastfeeding (≤ 6 mo):	
Advised about continuing breastfeeding	57.9
Advised about exclusive breastfeeding until 6 mo	21.1
Advised on complementary feeding	0.0
Recommend suspending breastfeeding	3.6
"Appropriate" advice about liquids intake as different from breast milk	10.5
Recommended breastfeeding on demand	31.6
Advised in case children are not gaining weight or remain hungry (≤ 24 mo)	35.3

* All values in percent | IYC: Infant and young child

Individual: Providers' lack of updated knowledge, motivation, and communication skills were identified as a barrier to advising mothers. PHC providers perceive breastfeeding as an activity mothers already know about and that they are capable of doing if they know its benefits. They lacked confidence about the nutritional adequacy of exclusive breastfeeding during the infant's first six months of life and considered breastfeeding detrimental

after one year. Malnutrition is still the most common nutritional concern.

Interpersonal: Providers expressed concerns regarding mothers accepting information and mothers' poor compliance as a disincentive to giving counseling. Counseling about infant feeding is a personal topic that injures susceptibilities and is gender-sensitive. Mothers' working conditions were identified as a barrier to

TABLE 2: Assessment of complementary feeding practices and recommendation during consultation. Healthcare providers' survey ($n = 56$).

Practices	Healthcare providers (physician and nurses) $n = 56^*$
Assessment of feeding	
Asked about type of liquids consumed by IYC 6–24 mo	13.5
Asked about type of food consumed by IYC 6–24 mo	48.6
Complementary feeding recommendations	
Advised about complementary feeding	26.8
Recommended introducing complementary food after 6 mo	12.5
Advised on how to initiate complementary feeding	17.9
Advised on type of food to initiate complementary feeding	25.0
Advised on consistency for complementary food	16.1
Advised on utensils to feed liquids to young children	14.3
Advised on frequency of complementary feeding	21.4
Advised about the Oportunidades program's fortified supplement	51.4
Advised about healthy diet (6–24 mo)	32.1
Advised on physical activity for children	3.6
Advised on what to do if the children do not want to eat	14.3
Advised on food manipulation and hygiene	26.8

* All values in percent | IYC: Infant and young child

the adequate promotion of complementary feeding practices, but did not emerge as a barrier to promoting breastfeeding.

Providers mentioned strong maternal beliefs and concerns affecting infant feeding practices, such as mothers' perceptions of having insufficient breast milk, difficulty or pain during the first weeks of breastfeeding, inadequate infant weight gain, colic, and child's acceptance of food.

Organizational: Providers are trained to focus on treatment rather than prevention. Time constraints force them to focus mainly on curative care. High turnover of physicians represents an important barrier to the ongoing training of personnel.

Community: Entrenched cultural practices, such as the early introduction of teas recommended by grandmothers and midwives, interfere with adequate breastfeeding practices. Providers and parents highly value infant formula and other milks, thus these are introduced in infants' diets early, along with sweetened beverages. In addition, there is the culturally accepted belief that "a chubby child is a healthy child."

Public policy: No national campaigns or programs promoting breastfeeding were seen in the study clinics. The Mexican official norm (NOM) for child healthcare is outdated and not in accordance with WHO guidelines – for example, it continues to establish exclusive breastfeeding until four months and does not include the 2006 WHO standards,⁴ which better represent the adequate growth of Mexican children,⁵ among others.

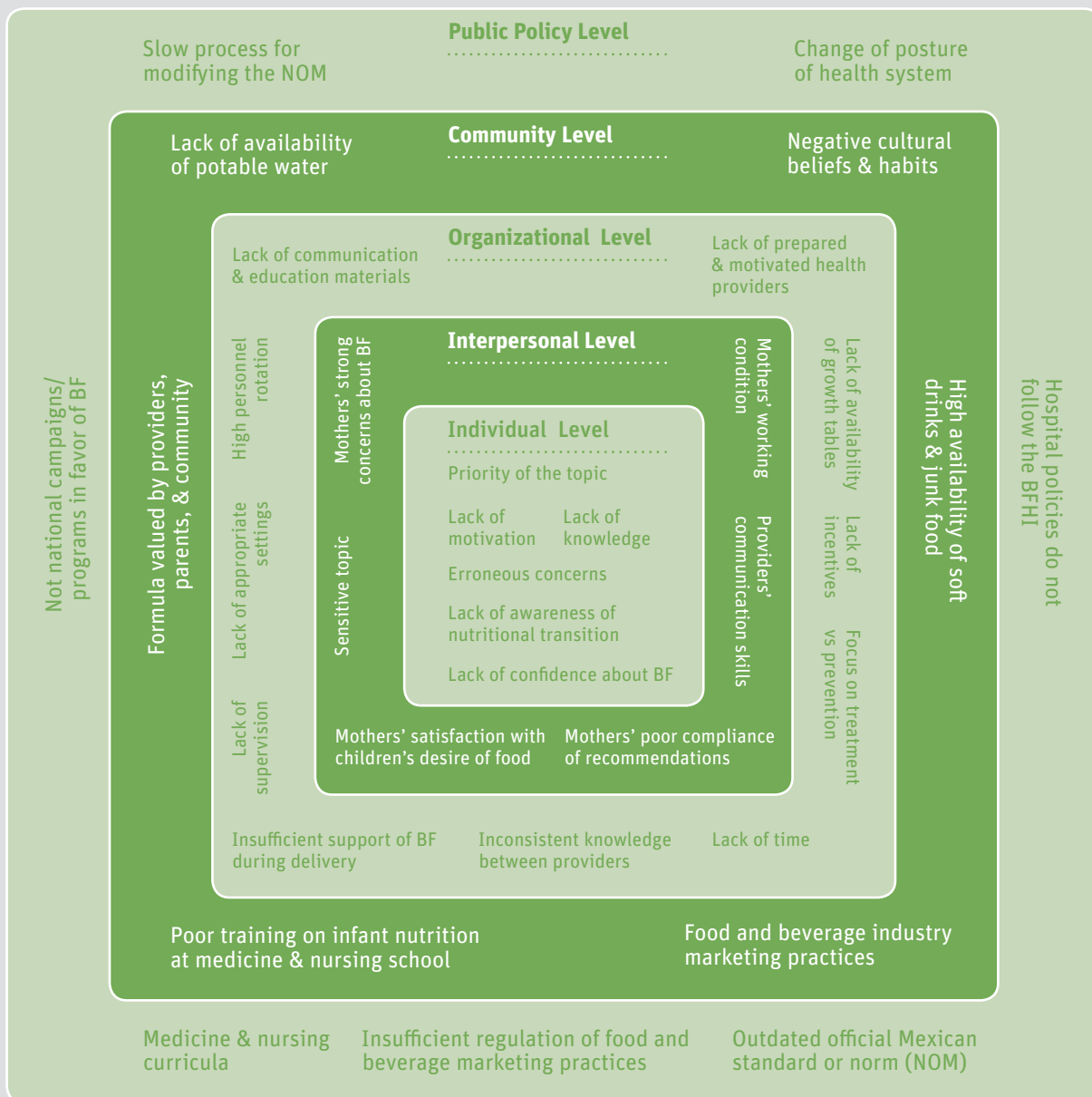
Conclusion and recommendation

The identification of barriers provides valuable information to help PHC services to promote healthy infant growth. Some recommendations were formulated. First, promoting healthy growth should become a priority for PHC, in order to prevent both infant malnutrition and obesity. It is essential that curricula in medical and nursing schools should emphasize a preventive rather than a curative approach and should include courses on infant feeding.

Secondly, a culturally sensitive intervention model to promote healthy growth – one that is better suited to the PHC organization and that takes into account barriers susceptible to modification – should be developed. Third, policies to enhance the promotion of healthy growth in PHC, given the constraints of busy practices, should become a priority for the health sector. The modification of the NOM to emphasize obesity prevention and address infant feeding recommendations, in accordance with WHO guidelines, is urgently needed.

Overcoming these barriers presents a challenge. However, malnutrition and obesity are much easier to prevent than to cure, so a strong commitment from health systems will be needed to place healthy infant growth on the healthcare agenda.

The original study was developed by researchers at the National Institute of Public Health in Mexico, working with staff from the National Commission for Social Protection in Health of the Mexican Secretariat of Health, who also funded the study [Ed.]

FIGURE 1: Barriers for the promotion of healthy infant growth at primary healthcare**Corresponding author: Anabelle Bonvecchio**

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References

- Johnson RB, Onwuegbuzie A J, Turner L.A. Toward a definition of mixed methods research. *Journal of Mixed Methods Research*. 2007;1(Suppl 2):112–33.
- McLeroy, K. R., Bibeau, D., Steckler, A et al. An ecological perspective on health promotion programs. *Health Education Quarterly*. 1998;15:351–77.
- PAHO/WHO: Guiding principles for complementary feeding of the breastfed child. Washington DC: Panamerican Health Organization, 2003.
- De Onís M, Onyango AW, Borghi E et al. Comparison of the World Health Organization (WHO) Child Growth Standards and the National Center for Health Statistics/WHO international growth reference: implications for child health programmes. *Public Health Nutr*. 2006;9:942–7.
- Gonzalez-de Cossio T, Rivera JA, González-Castell D et al. Child malnutrition in Mexico in the last two decades: prevalence using the new WHO 2006 growth standards. *Salud Pública de Mex*. 2009; 51(Suppl 4):S494–S506.

news

What's new

Did you know? You can now visit the *Sight and Life* website www.sightandlife.org on a regular basis to get the latest news of happenings in the field of nutrition, and you can follow us on **Facebook and Twitter @sightandlife**

01 Household Economy Approach & Cost of the Diet Website



Household Economy Approach & Cost of the Diet website

www.heawebsite.org is an exciting new web resource that hosts over 200 Household Economy Approach (HEA) and 18 Cost of the Diet (CoD) reports produced by numerous organizations since 2005. These reports provide much-needed information on aspects of food security, livelihoods, and nutrition in over 30 countries.

This website has been developed by Save the Children with support from the Food Economy Group (FEG) and with funding from ECHO. The intention is that this will be a low-maintenance website that will be updated largely by those working in this field, so we urge readers who are involved in such studies to share their findings and research so that these can be used locally, regionally, and globally to improve food security and nutrition-related policy and programming.

02 Online Training in the Management of Severe and Acute Malnutrition (SAM)

The University of Southampton and the International Malnutrition Task Force (IMTF) have developed a free web-based course to train health workers across the world in the management of Severe and Acute Malnutrition (SAM) in infants and children. The course is especially recommended for the wide group of professionals dealing with children who are suffering from malnutrition, such as nutritionists, doctors, nurses, and public health professionals. It is one

of three courses available, with the other two addressing nutrition state and assessment and measuring nutritional status to assess risk of ill health.

To sign up, go to

www.som.soton.ac.uk/learn/test/nutrition/Default.asp

A Global Research Agenda for Nutrition Science

The Sackler Institute for Nutrition Science, under the umbrella of the New York Academy of Sciences, and in collaboration with the World Health Organization, has launched a global initiative to formulate a research agenda for nutrition science.

A research advisory group was established that identified three broad categories where it was felt further research is most needed: environmental and societal trends affecting food and nutrition among vulnerable populations; unresolved issues of nutrition in the life cycle, with particular focus on the mother and child; and delivery of interventions and operational gaps.

Working groups were then assembled that further refined each focus area and identified a total of 25 key issues of high

interest and critical gaps in knowledge. This was followed by a web-based consultation to seek input from a broad cross-section of the nutrition community. More than 100 participants contributed to the discussion. In December 2012 a conference was held to discuss the findings, and a special issue of *Annals of the New York Academy of Sciences* will be published with peer-reviewed articles providing a more detailed analysis of the research gaps identified for each focus area.

For all the details and to subscribe to receive updates, visit www.nutritionresearchagenda.org.



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Academy of Sciences

The Philippines Embrace Multiple Micronutrient Powders (MNP)

The DSM-WFP partnership and its work related to the programming of MNP in both emergency and development settings in the Philippines has helped to influence national program guidance and policy in micronutrients, and the government of the Philippines has taken on MNP as one of its key interventions to be implemented nationwide in the coming years.

The National Nutrition Council, Department of Health, WFP, UNICEF, and Local Government units have worked closely together to develop the MNP Vita Mix packaging design to be used for this program, which is a component of the Millennium Development Goals Achievement Fund (MDG-F 2030) joint program for children and is aimed at increasing

food security and nutrition in the Zamboanga Peninsula. It is exciting to see interventions that benefit children being scaled up at country level, and *Sight and Life* remains committed to reporting on what is happening around the world as projects go to scale.

If you have a story to share, please write to us at info@sightandlife.org so that we can pass on the good news to others.

The SUN Keeps on Rising and Shining

The Scaling Up Nutrition (SUN) Movement continues to rise and shine, and now some 41 countries have signed up to it and shown their willingness to put nutrition at the center of their development plans.

The SUN website www.scalingupnutrition.org is the place to go to see who has joined and – more importantly, as we move from the commitment to the action phase of improving the nutritional status of millions around the world – to read country updates and to learn who is doing what, with whom, and how.

SUN Facts

- › The latest country to sign up to SUN is Haiti, with a population of nearly 10 million and a stunting rate of 23% among children under five years.
- › In Peru, the Mayor of Lima launched a “zero anemia” campaign aimed at benefiting 200,000 children.
- › In Guatemala, civil society has been awarded US\$ 428,000 to strengthen Scaling Up Nutrition by establishing a Monitoring and Social Audit Commission of Civil Society; strengthening a joint advocacy strategy of civil society; and initiating a massive communication campaign to inform and empower women, fortifying their capacity to demand quality health services for both mother and child.
- › A total of 20 SUN countries have currently collated costing information from diverse national nutrition-related plans and budgets. The total cost is equivalent to US\$7.7 billion per year. In 13 of the plans, the per capita annual cost is lower than US\$3.5. Specific nutrition actions, designed to directly impact nutrition status, targeting mostly women and children account for approximately US\$4 billion. The full report is available from the SUN website.

Venkatesh Mannar to Stand Down from the Micronutrient Initiative



Venkatesh Mannar

After almost 20 years as President of the Micronutrient Initiative (MI), Venkatesh Mannar will be transitioning out of this role at the end of 2013. He will, however, continue to support MI in an advisory capacity, so the nutrition world will not be losing his exceptional knowledge and precious insights.

Venkatesh Mannar has had a remarkable career with MI, building the organization from a staff of just four within the International Development Research Centre (IDRC) when he joined in 1994 to an independent organization with hundreds of dedicated workers worldwide and programs reaching at least 500 million people in 70 countries. As a testament to this contribution, he has won praise and many awards over the years, and Canada recently bestowed upon him its highest civilian honor, making him an Officer of the Order of Canada.

We at *Sight and Life* have enjoyed an excellent working relationship with Venkatesh, and we thank him warmly for his contribution, passion, and drive to improve global nutrition, especially the field of micronutrients. His efforts have led to programs that have improved the lives of millions.

FAO Appoints Director of Nutrition Division from Africa



Anna Lartey

Not only will Anna Lartey from Ghana become the new President of the IUNS at the upcoming conference in Granada, Spain, she will also take up the position of Director of Nutrition at the FAO from October 1, 2013.

This is wonderful news for the global nutrition community especially as nutrition and agriculture both recognize the need to work more closely together. Anna's dedication to nutrition is well known, as is her commitment to improving nutrition in developing countries. She has significant research work and related publications to her credit and has received several awards and extensive recognition for her work in nutrition, food, and agriculture, including Ghana Women of Excellence Awards 2012.

Sight and Life congratulates Anna, and we very much look forward to supporting her in her exciting and challenging new position.

The International Conference Against Child Undernutrition



Participants exchanging views on the five key challenges facing them

Some 400 participants joined in this meeting, which was held in Paris on May 14–15, 2013. The event helped strengthen the dialogue between stakeholders on five key challenges:

- › Integrating child undernutrition in a broader child health perspective and into social protection policies;
- › Improving availability and accessibility of nutrient-dense complementary foods for children 6–23 months old;
- › Developing multisector strategies combining both nutrition-specific and nutrition-sensitive interventions against undernutrition;
- › Mobilizing political will to place nutrition as a priority and sustainably increase funding; and
- › Changing paradigms, shifting from an emergency response mode to a lasting reduction of malnutrition for development.

The meeting report, as well as video recordings of all the sessions, is available at www.conference-malnutrition-infantile.fr/english-index.html.

Nutrition for Growth Summit

Ahead of the 2013 G8 Summit, UK Prime Minister David Cameron, along with the Children's Investment Fund Foundation and the government of Brazil, hosted a summit in London entitled Nutrition for Growth: Beating Hunger through Business and Science.

This event brought together many of the leaders whose contribution will be necessary to bring about global change, and it launched a seven-year initiative to tackle undernutrition. Substantial financial commitments were made, with US\$4.1 billion of new funding for nutrition-specific actions and US\$19 billion for nutrition-sensitive activities from now until 2020. The basis for allocation and the means through

which funds can be accessed will depend on the procedures favored by those who have made commitments.

It is expected to see negotiations taking place on a country-by-country basis to agree mechanisms for disbursement, and rigorous systems for monitoring and accountability will be essential.

The meeting signed a Nutrition for Growth Compact (available by searching Nutrition for Growth Compact in Google), and one of its commitments is to hold a global stocktaking meeting annually, in the margins of the United Nations General Assembly. This will start in September 2013, when feedback on the mechanisms for financing can be expected.

Advocating
better nutrition
for brighter
futures.

Sight and Life is a
humanitarian nutrition
think tank of DSM



BOOKS

Reviews & Notices

Editor’s note: This section contains reviews of books, publications, and websites that, whether brand new or classic, we hope will be of interest to our readers. Notices of relevant new publications that do not actually constitute reviews will from henceforth be published on www.sightandlife.org.

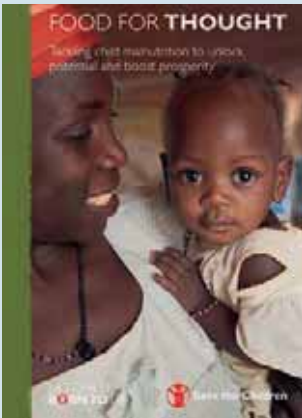
Giving Hope for Children of the World

The topic of child malnutrition has been the subject of many recent reports from a range of groups, and they all have one thing in common: the sense of hope, and the belief that with the right investment in the right interventions at the right time and the right scale, we can improve the lives of the world’s children. This it is not beyond our reach.

“Hope: A feeling of expectation and desire for a certain thing to happen”
Oxford English Dictionary

A Crucial Down Payment on Future Prosperity: Save the Children Publishes

Food for Thought: Tackling Child Malnutrition to Unlock Potential and Boost Prosperity



Between 1990 and 2011 there was a dramatic reduction in the death rate of children under the age of five years from 12 million to 6.9 million deaths per year, and primary school attendance also increased by 40 million children. Sadly, the effects of malnutrition continue to overshadow these positive results. A study that followed 3,000 children from four different countries found that stunted children scored 7% lower on math tests and were 13% less likely to be in the correct grade for their age. The effect of malnourishment also reaches beyond academic achievement. The research also shows an association between malnourished children and lower self-esteem, self-confidence, and

career ambitions, and malnourished children earn 20% less in adulthood in comparison to nourished children. The ripple effect ultimately negatively impacts on countries’ economic growth, with a reduction in GDP of between 2% and 11% as a result of malnutrition. Investing now in proven nutrition interventions is thus a “crucial down payment on future prosperity.” The reality highlighted in this report is that malnutrition often lacks a political champion and falls between the cracks of responsibility of ministries of health and agriculture.

Food for Thought: Tackling child malnutrition to unlock potential and boost prosperity
can be downloaded from www.savethechildren.org.uk/resources/online-library/food-thought

.....
"Now Is the Time to Accelerate:" UNICEF Publishes

Improving Child Nutrition: The Achievable Imperative for Global Progress

.....

This report gives the evidence that real progress is being made in the fight against stunted growth and shows that accelerated progress is both possible and necessary. It emphasizes that a key to success is indeed focusing attention on pregnancy and the first two years of a child's life. UNICEF Executive Director Anthony Lake stresses that stunting can

as it highlights successes in scaling up nutrition and improving policies, programs, and behavior change in 11 countries: Ethiopia, Haiti, India, Nepal, Peru, Rwanda, the Democratic Republic of the Congo, Sri Lanka, Kyrgyzstan, Tanzania and Viet Nam.

.....
It can be downloaded at
www.unicef.org/publications/index_68661.html
.....

kill opportunities in life for a child and thus kill opportunities for development of a nation, but he also gives hope with the words "Our evidence of the progress that is being achieved shows that now is the time to accelerate it." This report makes inspiring reading

Child Health Now: Together We Can End Preventable Deaths

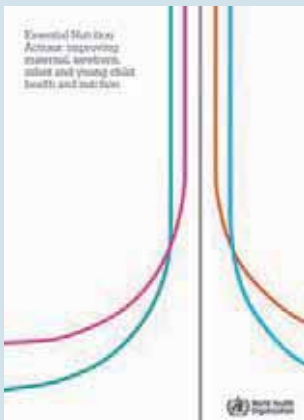
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The children who are most in need are within reach if governments, donors, multilaterals, and civil society choose the right ways to target them. This is the overriding message of this report from World Vision International. It highlights an often overlooked strategy that is key to keeping children healthy: engaging and empowering families and communities in taking control of their own health. The report proposes a number of community-based strategies to effectively engage and empower families and communities for improved child health outcomes.

The report is available to download at
www.childhealthnow.org/docs/en/chn-within-reach_final.secure.pdf
.....

WHO Publishes Two Key Documents

Essential Nutrition Actions: Improving Maternal, Newborn, Infant and Young Child Nutrition



This report is a valuable compendium of the WHO guidance on effective nutrition programs, which is much needed when once again the Lancet series has highlighted the need to scale up nutrition interventions targeting the first 1,000 days of life. The report is easy to read and the layout is useful, as it is organized in stages of the life

course from pre-conception through the first two years of life to women of reproductive age and pregnant women. It also covers global interventions such as wheat and maize flour fortification,

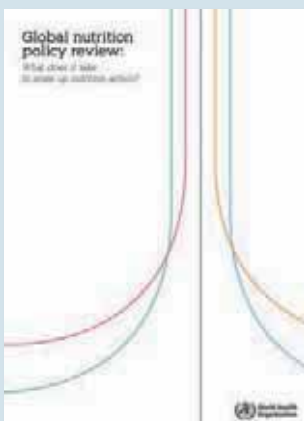
and other interventions with an impact on nutrition.

Part I presents the interventions currently recommended by WHO, summarizes the rationale and the evidence, and describes the actions required to implement them. Part II provides an analysis of community-based interventions aimed at improving nutrition and indicates how effective interventions can be delivered in an integrated fashion. This report is a must read and a key reference document for anyone working in the field of public health nutrition

It can be downloaded from

www.who.int/nutrition/publications/infantfeeding/essential_nutrition_actions/en/index.html

The Global Nutrition Policy Review: What Does It Take to Scale Up Nutrition Action?



This review is based on a questionnaire survey conducted during 2009–2010, in which 119 WHO member states and four territories took part. It examines current global nutrition challenges, from infant and young child feeding to adult overweight and obesity, and vitamin and mineral malnutrition. The review

analyzes information on whether the participating countries have nutrition policies and programs and, if so, what topics the policies cover; how they are being implemented; what the implementation coverage is; who the stakeholders are; what

coordination mechanism exists; and how the monitoring and evaluation are being implemented.

Two key comments made are that improving nutrition requires a comprehensive approach to policy response and its implementation, adapted to each country's context and that the coordination of multiple stakeholders and interest groups is critical.

The report can be downloaded from

http://apps.who.int/iris/bitstream/10665/84408/1/9789241505529_eng.pdf

A New Global Partnership: Eradicate Poverty and Transform Economies Through Sustainable Development

The debate is shifting, and the post-2015 development agenda is a key topic in many forums. This practical report published by the United Nations was written by a 27-person panel of eminent persons and was delivered to Secretary-General Ban Ki-moon on May 30, 2013. It is based on extensive consultation in every region and across many sectors, gives recommendations for a transformation to end poverty, and provides an example of how new goals and measurable targets could be framed. It aims to stimulate debate concerning the prioritization that will be needed if the international community is to agree on a new development framework before the expiration of the MDGs. Key questions are what to keep, what to amend, and what to add, in light of the massive changes in the world since the year 2000 and the changes that are likely to unfold by 2030.

Five transformational shifts are proposed:

- 1. Leave no one behind;
- 2. Put sustainable development at the core;

- 3. Transform economies for jobs and inclusive growth;
- 4. Build peace and effective, open, and accountable institutions for all; and
- 5. Forge a new global partnership.

In addition, 12 goals and targets are suggested, and these include Goal 5 – Ensuring food security and good nutrition. Some possible targets are suggested but not yet fully defined.

To read more and start engaging in the conversation, visit

www.un.org/sg/management/pdf/HLP_P2015_Report.pdf

We'd very like to hear from you on what you see as the key priorities, especially with regard to nutrition and nutrition-related targets, as we head towards the post-MDG era. Please drop us an e-mail at info@sightandlife.org.

Feeding and Urban World: A Call to Action



Today, more of the global population lives in urban centers than in rural communities. While cities often provide increased opportunities for employment and education, they can also leave a significant portion of their population food-insecure. The Chicago Council on Global Affairs 2013 brought together 20

young leaders from various sectors of the city who decided to draw attention to the challenges of feeding an urban world

and propose ways for governments, civil society organizations, the private sector, and community groups to begin to examine their own cities and plan for needed changes.

Defining urban food security: “Urban food security is when urban residents have sustained physical, economic, and social access to safe, sufficient, diverse calories and micronutrients required for a healthy lifestyle.”

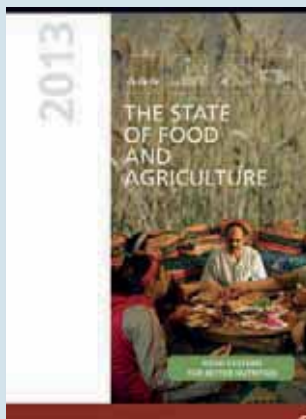
The document proposes an Urban Food Model that provides an approach to manage “urban food readiness” in the decades ahead. The focus of the model is on the supply chain from production centers to urban markets, on distribution networks within cities, urban safety nets, and formal and informal institutions for food distribution and consumption within metropolitan areas using availability, access, and utilization as the pillars. It is designed to help focus conversations and policy on relevant food security questions in an urban context.

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The report makes interesting reading for anyone working in nutrition in the context of urban settings and can be downloaded via
www.thechicagocouncil.org/UserFiles/File/Emerging%20Leaders%20Program/EL_2013_UrbanFoodSecurity.pdf
.....

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FAO

The State of Food and Agriculture 2013: Food Systems for Better Nutrition

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This report argues that improving nutrition and reducing its cost must begin with food and agriculture. The traditional role of agriculture in producing food and generating income is fundamental, but agriculture and the entire food system – from inputs and production, through processing, storage, transport, and retailing, to

consumption – can contribute much more to the eradication of malnutrition.

development priorities must be made more nutrition-sensitive, with a stronger focus on nutrient-dense foods such as fruits, vegetables, legumes and animal-source foods. It also covers supply chain and consumer choice issues as well as the institutional and policy environment. As we try to break down the silos in which we have traditionally operated, it is essential that nutritionists take time to read this report and understand the nutrition issues from the perspective of the FAO.

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The report is available at
www.fao.org/docrep/018/i3300e/i3300e00.htm
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Better nutrition depends on every aspect of the food system

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Food systems encompass all the people, institutions, and processes by which agricultural products are produced, processed, and brought to consumers. This report highlights many areas where agriculture can play a greater role in supporting nutrition, including the fact that agricultural research and

Hunger and Nutrition Commitment Index (HANCI): Measuring the Political Commitment to Reduce Hunger and Undernutrition in Developing Countries

As nutrition interventions increasingly take center stage, this new index is a great tool to assess the extent of government commitment to reduce both hunger and undernutrition. It will help focus support and keep up the pressure for change. The index compares 45 developing countries in terms of their performance on 22 indicators of political commitment to reduce hunger and undernutrition in 2012. Although a number of key findings are highlighted, Guatemala comes top in terms of hunger and nutrition commitment, while Guinea Bissau shows the lowest level of political commitment to reduce hunger and undernutrition.

To read more interesting facts, download the HANCI report from the Institute of Development Studies website:

www.ids.ac.uk/files/dmfile/HANCI_2012_reportv2.pdf

To explore the excellent interactive website, visit

www.hancindex.org/

Vitamin History: The Early Years

Dr Lee McDowell is a professor of Nutrition at the University of Florida who has for many years found the early history of vitamins fascinating. During the 25-year period while he was offering a graduate vitamin nutrition course, he wrote two editions of a vitamin textbook. Now a wider audience can enjoy reading this book, which contains 10 chapters and traces each vitamin from an unidentified factor to its discovery and synthesis. Dr McDowell's book is written in both an informative and a humorous way. This is a must-have book for anyone who is interested in vitamins or who lectures on the subject. It is available both as an e-book and in hard copy.

The publisher is First Edition Design Publishing (www.firsteditiondesignpublishing.com), and the ISBN numbers are as an e-book 9781622872527 and as a print book 9781622872664.

The Lancet Maternal and Child Nutrition Series 2013

In June 2013, the much anticipated Lancet Nutrition Series was launched. We present a brief summary of the four papers in that series and comments for moving ahead in maternal and child nutrition. The new series is available at www.thelancet.com/series/maternal-and-child-nutrition.

Paper 1. Black et al. *Maternal and child undernutrition and overweight in low-income and middle-income countries.*

This paper outlines the prevalence and consequences for under nutrition and overweight in low- and middle-income countries. The overall theme is the need for a life-cycle approach to nutrition and health. Short stature of adolescent women can increase the risk of birth complications, while nutritional status at the time of conception and throughout pregnancy is core to good fetal development. Low maternal BMI has fallen since 1980, but remains over 10% in Africa and Asia, while maternal overweight and obesity continue to increase around the globe. Fetal growth restriction as represented by being born small for gestational age (SGA) results in an increased risk of neonatal and infant mortality, and those born SGA who survive past infancy have a significantly higher risk of being stunted. Micronutrient deficiencies of vitamin A and zinc continue to be a prominent cause of child death, while deficiencies of iron and iodine can be barriers to achieving optimal mental development. The authors estimate that the aggregate of fetal growth restriction, stunting, wasting, and of vitamin A and zinc deficiencies in addition to suboptimum breastfeeding resulted in 45% of all child deaths in 2011. This equates to a total of 3.1 million child deaths. **Table 1** summarizes the nutritional causes of child deaths. In 2011, 165 million children under five remained stunted, 90% of them living in just 34 countries. Wasting continues to affect 52 million children, while the prevalence of overweight and obesity in children is increasing. The paper reaffirms the importance of the “1,000-day” window of opportunity for ensuring optimal child growth and development, with significant implications for health in adulthood.

Paper 2. Bhutta et al. *Evidence-based interventions for improvement of maternal and child nutrition: what can be done and at what cost?*

Paper 2 reviews the evidence for nutrition-specific interven-

tions for maternal and child nutrition, health, and survival. The authors use the Lives Saved Tool to model the effect of scaling up 10 evidence-based nutrition interventions to 90% coverage in the 34 highest-burden countries. The 10 interventions are outlined in **Figure 1**.

If these 10 interventions were to achieve 90% coverage, then one could expect an estimated 15% reduction in child deaths (1 million lives saved), a 60% reduction in wasting, and a 20% reduction in stunting for children under five years of age. The biggest challenge for the nutrition field is to ensure that these interventions are implemented on a large scale.

The second paper also addresses key areas where the evidence base is weak. Particularly, this relates to complementary feeding strategies between 6–23 months of age in settings without access to a diverse, nutrient-dense diet. Adequate complementary feeding is considered an important intervention throughout the life cycle but Bhutta et al. suggests that the existing evidence base for use of fortified complementary food products is weak. Areas that require further attention in order to strengthen the evidence base include improved targeting to those with inadequate micronutrient status, improved product formulation, acceptability, and adequate fortification levels, and good impact evaluation designs. Current trials on fortified complementary foods in Africa and Asia should provide much-needed evidence for the role of complementary foods in scaling up nutrition.

Paper 3. Ruel et al. *Nutrition-sensitive interventions and programs: how can they help to accelerate progress in improving maternal and child nutrition?*

Paper three reviews the evidence for nutrition-sensitive interventions in four sectors: agriculture, social safety nets, early child development, and schooling.

Agriculture programs increase access to diverse nutritious food and generate income, but their impact on nutrition outcomes is inconclusive, which may largely be a consequence of poor project evaluations. Social safety nets are a poverty reduction tool, and ~1 billion people are beneficiaries of these programs, which increase access to food and increase dietary diversity at the household level. However, the impact of social safety nets on nutrition outcomes has been disappointing, which may be a result of poor timing and duration of interventions, plus the quality of existing healthcare services. Girls' schooling is key for poverty alleviation and health because educated girls are less likely to have stunted children, and schooling increases individual earning capacity, which can have benefits on nutrition outcomes.

Understanding the interplay between these sectors and nutrition is a major task for the nutrition field. Nutrition-sensitive interventions can increase capacity and promote cost-saving when interventions are implemented in tandem. The key will

TABLE 1: Global deaths in children younger than five years attributed to nutritional disorders. Adapted from; Black et al. The Lancet Maternal and Child Nutrition Series, 2013.

Deaths attributed to nutritional disorders	Attributable deaths with UN prevalences	Proportion of total deaths of children younger than 5 years
Joint effects of fetal growth restriction, suboptimal breastfeeding, stunting, wasting, and vitamin A and zinc deficiency (<5 years)	3,097,000	44.7%
Joint effect of fetal growth restriction and suboptimal breastfeeding in neonates	1,348,000	19.4%
Stunting (1–59 months)	1,017,000	14.7%
Underweight (1–59 months)	999,000	14.4%
Wasting (1–59 months)	875,000	12.6%
Severe wasting (1–59 months)	516,000	7.4%
Fetal growth restriction (<1 month)	817,000	11.8%
Suboptimal breastfeeding	804,000	11.6%
Vitamin A deficiency (6–59 months)	157,000	2.3%
Zinc deficiency (12–59 months)	116,000	1.7%

All data are to the nearest thousand.

be to ensure that programs are of high quality and have robust monitoring and evaluation components.

Paper 4. Gillespie et al. *The politics of reducing malnutrition: building commitment and accelerating progress.*

The final paper demonstrates the recent gains in leveraging political will for (a) tackling undernutrition and (b) building sustained commitment for making nutrition a development priority. The Scaling Up Nutrition (SUN) Movement has provided the basis to harmonize, prioritize, and build a platform for moving nutrition policy forward.

The paper addresses the key question of how to build on recent successes and ensure that commitment to nutrition continues. The authors use a six-cell framework with three key domains for transforming momentum into results: knowledge and evidence, politics and governance, and capacity and resources. Building accountability is key to achieving medium- and long-term success, and governments, international organizations, NGOs and the private sector must all be accountable for the quality and outcomes of their programs. The need to build organizational and strategic capacity is an overarching issue.

In summary, the Maternal and Child Nutrition series notes that if we were to implement 10 proven interventions (classified into four packages; summarized in **Figure 1**) to 90% coverage, then we would achieve a 15% reduction in deaths of children under five years, and stunting could be averted in 20% of children.² Gillespie et al. further discuss policy and leadership elements that are necessary to ensure that nutrition is supported and enabled through the policy process, issues that have been given very little attention by the nutrition community.⁴

Both the Lancet Nutrition Series of 2013, and especially that of 2008, have been instrumental in helping to align nutrition policies, leverage funds, increase political and donor interest in nutrition, and bring nutrition to the forefront of the global development agenda. The focus now, however, must shift to actions on the ground. In contrast to the aforementioned high-level successes, the next phase will require a much more bottom-up approach. Health sector coverage for nutrition interventions are variable and moderate, at best.⁵ Even in countries where the political will and the funding exists for implementing programs, the main bottleneck to scaling up continues to be a usable set of tools that would allow program staff to implement interventions within existing health, agriculture, and education systems. Thus, the major question now for the nutrition community is, how does one deliver the 10 interventions to 90% of our most vulnerable population, and ensure that the interventions are used as intended?

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Authors: Henry Mark and Eva Monterrosa

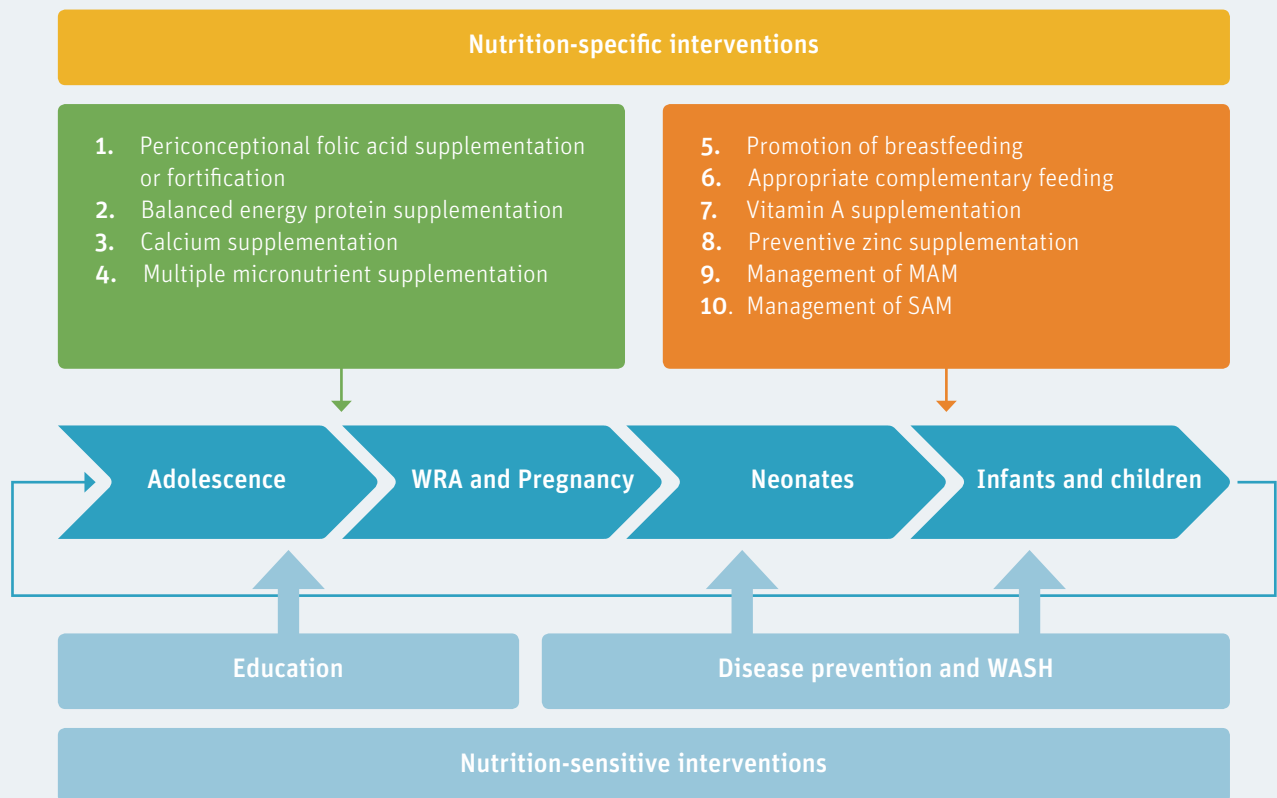
Affiliations: *Sight and Life, Basel, Switzerland*

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References:

- Black RE, Victora CG, Walker SP et al. Maternal and child undernutrition and overweight in low-income and middle-income countries. The Lancet. June 6 2013. Internet: www.thelancet.com/series/maternal-and-child-nutrition

FIGURE 1: Conceptual framework for nutrition-specific interventions promoting child survival and optimal growth and development, leading to better nutritional status in adolescence and adulthood and helping to break the intergenerational cycle of malnutrition. Adapted from: Bhutta et al. The Lancet Maternal and Child Nutrition Series, 2013.



Abbreviations: women of reproductive age (WRA); water, sanitation, and hygiene (WASH); management of moderate acute malnutrition (MAM); management of severe acute malnutrition (SAM)

02. Bhutta ZA, Das JK, Rizvi A et al. Evidence-based interventions for improvement of maternal and child nutrition: what can be done and at what cost? *The Lancet*. June 6, 2013. Internet: www.thelancet.com/series/maternal-and-child-nutrition
03. Ruel MT, Alderman H, and the Maternal and Child Nutrition Study Group. Nutrition-sensitive interventions and programs: how can they help to accelerate progress in improving maternal and child nutrition? *The Lancet*. June 6, 2013. Internet: www.thelancet.com/series/maternal-and-child-nutrition
04. Gillespie S, Haddad L, Mannar V et al. The politics of reducing malnutrition: building commitment and accelerating progress. *The Lancet*. June 6, 2013. Internet: www.thelancet.com/series/maternal-and-child-nutrition
05. Lutter CK, Daelmas B, de Onis M et al. Undernutrition, Poor Feeding Practices and Low coverage of Key Nutrition Interventions. *Pediatrics* 2011;128:e1418.

Sight and Life publishes
Global Hidden Hunger Indices and Maps:

An Advocacy Tool for Action

Sight and Life has created the first ever Hidden Hunger Index. This analysis identifies global hot spots of micronutrient deficiencies for the first time.

Published in the journal PLOS ONE, the Hidden Hunger Index maps and rankings offer the health and development community an evidence-based tool to target the alleviation of multiple micronutrient deficiencies, which is critical to achieving many of the Millennium Development Goals.

Key messages

- > An estimated 2 billion people are affected by deficiencies of essential vitamins and minerals, collectively known as “hidden hunger.” Young children and women of reproductive age in developing countries are the hardest hit.
- > In most of the 20 countries with the highest Hidden Hunger Index scores, 40% of preschool children were estimated to be stunted, more than 30% were anemic due to iron deficiency and more than half were vitamin A-deficient.
- > A number of countries in sub-Saharan Africa, as well as India and Afghanistan in Asia, had an alarmingly high level of hidden hunger, with stunting, iron deficiency anemia, and vitamin A deficiency all being highly prevalent among preschool children.
- > In 36 countries, home to 90% of the world’s stunted children, micronutrient deficiencies, especially vitamin A and zinc, were responsible for up to 12% of the total number of life years lost (DALYs) due to ill health, disability, or early death.
- > Countries with high Human Development Index scores tended to have low Hidden Hunger Index scores and vice versa, highlighting the importance of addressing hidden hunger in order to achieve adequate development, improve health care and education and vice versa.

Supporting a new development agenda

We are moving toward a new development agenda. The world is embracing the critical role of nutrition in improving health and increasing prosperity. And nations are beginning to implement plans to scale up nutrition. The new Lancet Series on Maternal and Child Nutrition has called for maternal multiple micronutrient supplementation as a key intervention that can save 102,000 lives per year as part of a package of interventions during pregnancy.

Another 145,000 lives could be saved through vitamin A and zinc supplementation for children, according to the Series. The papers also called for better data on micronutrient deficiencies at the national level to help guide intervention programs in countries and to prioritize global support.

By highlighting global hidden hunger hot spots and providing, for the first time, a ranked index of countries affected by multiple micronutrient deficiencies, the Hidden Hunger Index begins to fill this gap in the evidence base. The Hidden Hunger Index provides the global health and development community with evidence to inform where to focus national strategies and programs, and on which micronutrients. To countries, donors and partners working to scale up nutrition, it offers an opportunity to develop a unified approach to target the alleviation of hidden hunger.

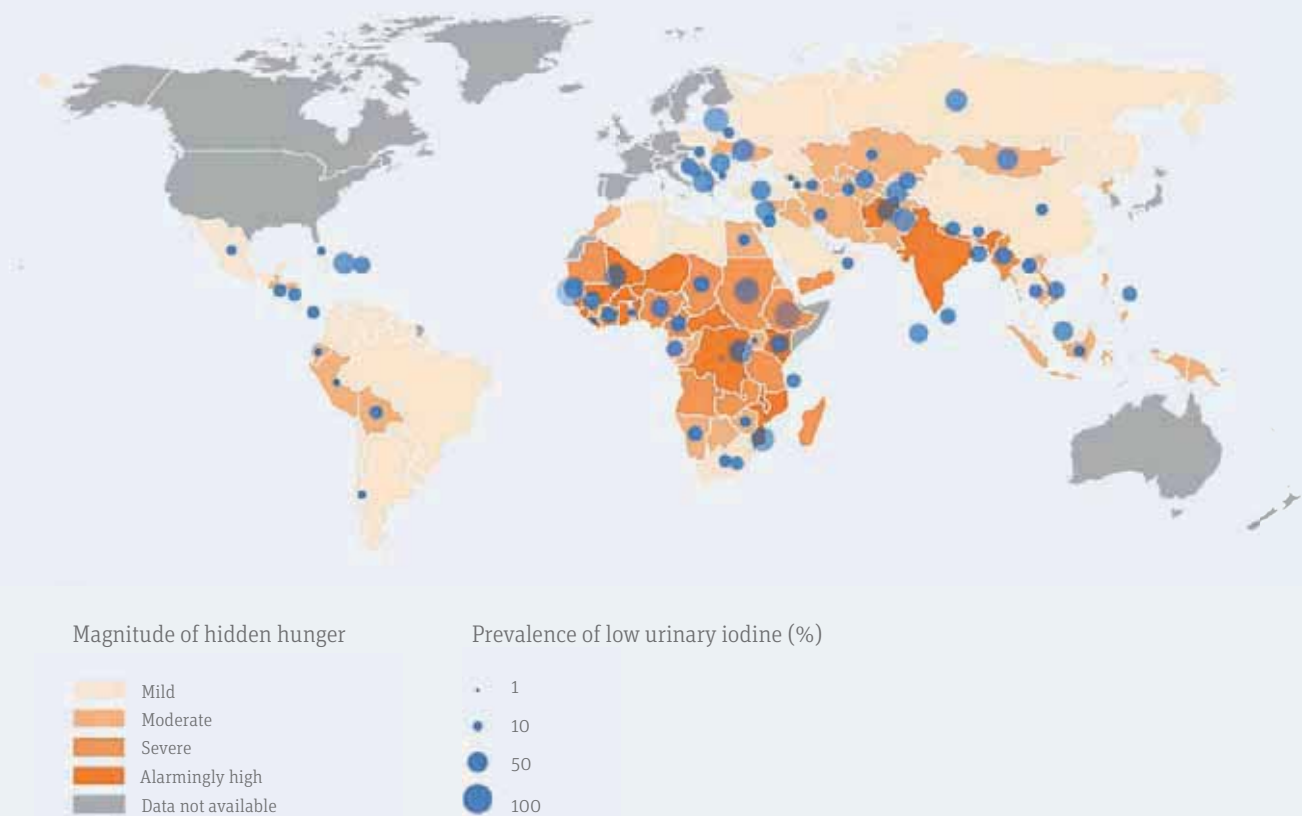
“The Hidden Hunger Index offers an opportunity to develop a unified approach to target the alleviation of hidden hunger”

The Impact of hidden hunger

Globally, an estimated 2 billion people suffer from a chronic deficiency of essential vitamins and minerals (micronutrients), a condition known as hidden hunger. As the term hidden hunger indicates, the signs are not always visible in those affected by it. Nevertheless, its negative and often lifelong consequences for health, productivity, and mental development are devastating. Young children and women of reproductive age living in low-income countries are the most vulnerable.

Worldwide, the most widespread micronutrient deficiencies are of iron, zinc, vitamin A, iodine, and folate, but deficiencies of vitamin B₁₂ and other B vitamins also commonly occur. In developing countries, multiple micronutrient deficiencies often occur concurrently in the same population. These deficiencies account for approximately 7% of the global disease burden annually. Even mild to moderate deficiencies

FIGURE 1: Magnitude of hidden hunger (zinc, iron and vitamin A deficiencies), prevalence of iodine deficiency.



of micronutrients lead to impaired physical and cognitive development, poor physical growth, increased morbidity from infectious diseases in infants and young children, and decreased work productivity in adulthood.

About the Hidden Hunger Index

Unified global efforts to mitigate the high burden of hidden hunger in populations around the world are crucial to the achievement of most of the Millennium Development Goals (MDGs). However, a strong evidence base of the burden of collective micronutrient deficiency and its contributions to disease, both nationally and globally, has been lacking. Earlier indices such as the Global Hunger Index, reflecting measures of food security, undernourishment, and child mortality, captured the multidimensional aspects and consequences of hunger caused mainly by food and caloric deficit, and did not take into account the burden and consequences of pervasive hidden hunger. Maps depicting single micronutrient deficiencies have served to inform policy-makers and the scientific community of the extent of individual vitamin and mineral deficiencies, but do not illustrate the more commonly observed multiple micronutrient deficiencies.

Sight and Life developed indices and maps of global hidden hunger to help prioritize program assistance and to serve as an evidence-based global advocacy tool. The global hidden hunger indices and maps capture the collective burden of micronutrient deficiencies and their contribution to the disease burden. Indices and maps are useful tools for public health advocacy and planning, and can serve as a tool to stimulate global efforts towards scaling up nutrition interventions. The Hidden Hunger Index was developed in consultation with high-level scientists, academics and decision-makers from a range of global institutions, including UN agencies, US government agencies, universities, and international NGOs.

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The paper was published in the journal PLOS ONE,
and can be viewed at www.plosone.org/article/info:doi%2F10.1371%2Fjournal.pone.0067860

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“The Hidden Hunger Index was developed in consultation with high-level scientists, academics, and decision-makers”

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Hidden Hunger Index: Key findings

Globally, there were hot spots of hidden hunger for preschool-age children, with the prevalence being alarmingly high in sub-Saharan Africa, India and Afghanistan, and severe in many countries in South-Central/Southeast Asia.

Low-quality, micronutrient-poor diets, as well as frequent infections, are likely to be the key causal factors, further compounded by poor economic conditions and repressive political systems. Most South American countries only had a mild-to-moderate degree of hidden hunger. Of the 20 countries with the highest Hidden Hunger Index scores, 18 were in sub-Saharan Africa and two, India and Afghanistan, were in Asia. Of the 149 countries with a 2007 Human Development Index score of less than 0.9, the country with the highest Hidden Hunger Index score was Niger and the lowest was Hungary. For preschool children in most of the 20 countries with the highest Hidden Hunger Index scores, more than 40% were estimated to be stunted/zinc-deficient, 30% were anemic due to iron deficiency, and 50% were vitamin A-deficient. The DALY-based indices and maps were intended to capture the consequences of micronutrient deficiencies globally. In 36 countries, home to 90% of the world’s stunted children, micronutrient deficiencies, especially vitamin A and zinc, were responsible for up to 12% of the total number of DALYs. Countries in sub-Saharan Africa, such as Sierra Leone and Niger, exhibited the highest levels of population-adjusted disease burden attributed to micronutrient deficiencies.

A high Hidden Hunger Index score was strongly correlated with a low Human Development Index score (a composite measure of three basic dimensions of human development: a long and healthy life, education, and standard of living), and vice versa. This highlights the importance of addressing hidden hunger in order to achieve adequate development, reduce general deprivation, and improve healthcare and education.

In many countries, the Hidden Hunger Index score was high even though the percentage of the population not getting enough dietary energy (calories) was low, confirming that the Hidden Hunger Index measures a form of hunger associated with micronutrient deficiency, rather than energy deficiency.

Iodine deficiency did not correlate with the other micronutrient deficiencies, likely because of varying country laws

mandating salt iodization. The greatest proportions of children with iodine deficiency were in the Eastern Mediterranean (47%), European (44%) and African (40%) regions.

A tool for advocacy

The Hidden Hunger Index and maps provide much-needed information on the collective magnitude and distribution of multiple micronutrient deficiencies across the globe, and their attributed disease burden. They provide a useful tool for advocates to illustrate the real need for multiple micronutrient interventions to address hidden hunger. In addition, they provide useful information for policy-makers in decision-making and prioritizing interventions, and offer valuable information for public health scientists as a basis for action, and subsequent monitoring and evaluation of preventive programs.

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“The Hidden Hunger Index and maps provide much-needed information on the magnitude and distribution of multiple micronutrient deficiencies across the globe”

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One application of the Hidden Hunger Index is for countries in the Scaling Up Nutrition (SUN) Movement. The current and growing support for the SUN Movement illustrates the unprecedented global political will to prioritize food and nutrition security as being central to development and the achievement of the Millennium Development Goals, as well as the post-2015 goals currently in development. The main investors in SUN are national governments themselves. Governments require tools that enable them to make informed policy and budget decisions.

The Hidden Hunger Index enables the development of appropriate interventions, such as home fortification with micronutrient powders for preschool-age children, multiple micronutrient supplementation for pregnant women and food fortification for the general population, which can effectively target those populations most affected by micronutrient deficiencies. In this way, the Hidden Hunger Index can be used as an advocacy tool to target the alleviation of hidden hunger.

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