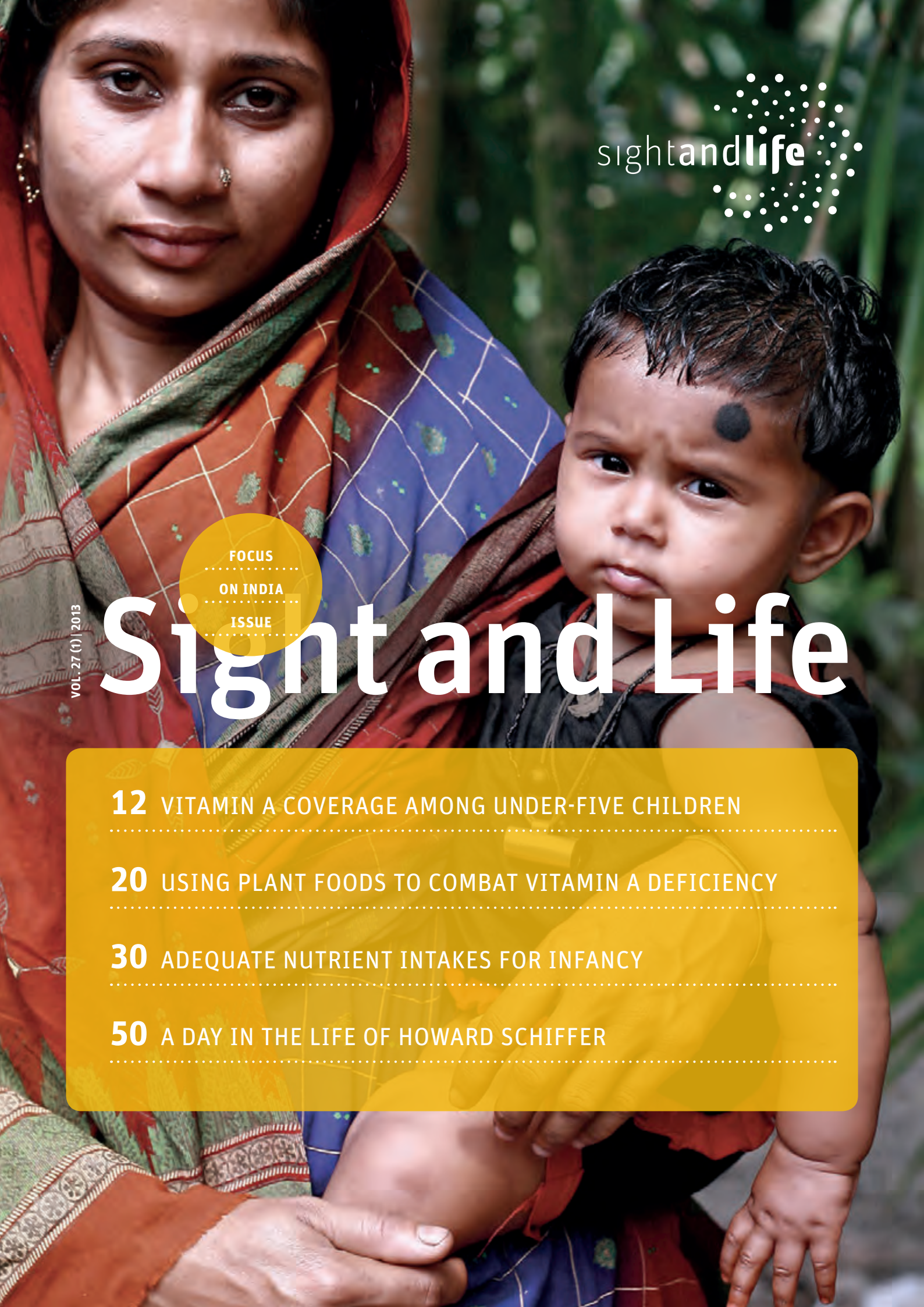

sightandlife

FOCUS ON INDIA ISSUE

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Contents

“The process …

… I have described – setting clear goals, picking the right approach, and then measuring results to get feedback and refine the approach continually – helps us to deliver tools and services to everybody who will benefit. This innovation to reduce the delivery bottleneck is critical.”

Bill Gates, Annual Letter 2013 [5]

Welcome

Nutrition Evidence – the Challenge of Moving to Implementation Assessment

It's with some irony that this India special of *Sight and Life* Magazine coincides with the publication of the Deworming and Enhanced Vitamin A (DEVTA[1]) study. While the DEVTA study represents an earnest attempt to evaluate a large Government of India program delivering vitamin A to children, it contradicts the results of a number of randomized controlled trials (RCTs) carried out in different regions, which have conclusively demonstrated that vitamin A supplementation to children under the age of five every four to six months results in a 24% reduction in under-five mortality. DEVTA, however, showed only a non-significant 4% reduction in child mortality. The reasons for this lack of effect are likely to be found in how the program was run and evaluated – the problems it experienced are common in large intervention strategies and point to the urgent need for us to consider how scaled-up implementation research should best be undertaken.

It is legitimate that governments and donors demand the best possible scientific evidence to make informed decisions regarding nutrition programs. But how much and what kind of evidence is required before going forward with interventions that potentially reduce morbidity and mortality? Should such decisions always be based on RCTs and meta-analyses? In a paper published last year, we emphasized the totality of evidence gathered from epidemiology, basic science, and meta-analyses to inform policy and guideline development for program implementation, with close collaboration between program planners and scientists.[2]

But what should we focus on to further advance the continuum of evidence? Keeping the DEVTA experiences in mind, it is my opinion that increasing efforts should be directed at assessing how well programs are implemented and how implementation affects their impact. RCTs utilize an "intention-to-treat" analysis, where program coverage, compliance or baseline nutritional status are not considered in the main analysis. We should take advantage of the RCT design, but also include monitoring and process evaluation activities to gather systematic data on the fidelity of implementation (e.g., was the right dose provided, how well were mothers counseled, how well were messages delivered, and so on); program coverage (e.g., how many children received the intervention, and how often); and utilization (e.g., how well did mothers use the information or supplement provided, how much of the supplement was wasted or shared, and what other socio-biological factors could have affected program utilization). These data could be used in the final analysis and must be utilized to contextualize study results.[3]

This approach advances the continuum of evidence and shifts the focus of addressing micronutrient malnutrition to a wider socio-cultural perspective, forcing us to consider the myriad of factors that can profoundly alter how well a program is implemented. Last December, at a meeting of the New York Academy of Sciences,[4] Jean-Pierre Habicht of Cornell University highlighted the real dilemma – 80% of child deaths could be prevented by improving program delivery, but implementation research only receives 3% of research funding. Therefore, delivery research is of utmost importance in analyzing processes, detecting bottlenecks and offering solutions to ensure that the expected goals are being met.

Before implementation starts, a thorough assessment of the program setting and participants – deploying qualitative and quantitative research methods – is required. Nutrition programs would benefit from a multidisciplinary systems approach, with a specific integration of social and biological concepts and expertise. We need more ethnographic and formative research to understand the target population in its socioeconomic and cultural context, in addition to food production, preparation, preferences, consumption and many other factors. For micronutrient interventions, it should be a matter of course to select populations that are micronutrient-deficient, and use

the right dose and delivery form. However, I have observed a number of RCTs involving micronutrients that were undertaken based on incorrect assumptions regarding the type and magnitude of the deficiency problem. This is a waste of resources. For example, hemoglobin is frequently used as a proxy indicator for not only iron deficiency, but also as a more general indicator of overall micronutrient status. However, the specificity of this biomarker is poor due to the influence of other factors known to affect hemoglobin concentrations such as certain disease states (i.e., HIV / AIDS, hemoglobinopathies), parasitic infections, and other micronutrient deficiencies (i.e., vitamin A, B_{12}, riboflavin and folate). Therefore, we need better, cost-effective indicators / biomarkers to measure the nutritional status of populations.

This is why *Sight and Life* has partnered with the National Institute of Child Health and Human Development (NICHD), supported the BOND (Biomarkers on Growth for Development) program, and recently initiated a new program to improve the assessment of nutrition interventions on growth. This initiative is called "Biomarkers in Growth" (BIG).

It is commendable that the World Health Organization (WHO) has established an electronic library of Evidence for Nutrition Actions (eLENA) for safe and effective micronutrient interventions, and a Global Database on the Implementation of Nutrition Actions (GINA) – a collection of policy documents and action reports. However, a substantial amount of evidence is lost because field reports are not yet systematically collected or even published in peer-reviewed journals as required by WHO's systematic reviews methodology. Increasingly, the Food and Nutrition Bulletin has taken on this role of collecting and sharing program experiences, but more platforms for knowledge-sharing are urgently needed.

There are many lessons to be learned from the DEVTA trial, with respect to both delivery and design, implementation, and resources needed for monitoring and evaluating programs. However, the evidence supporting vitamin A supplementation should continue to be based on well-designed and controlled clinical trials. Focusing on the impact evaluation of a poorly-implemented program alone sends the wrong message and undermines a great deal of excellent research carried out over many years – especially when the lives of millions of children are at stake.

With best regards,

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Priorities in evidence-building and programming

- Assess baseline nutritional status of target population
- Carry out ethnographic and formative research to understand the target population in its socioeconomic and cultural context
- Conduct thorough program monitoring and evaluation, including assessment of nutritional impact
- Better understand the complex biological and social aspects of micronutrient interventions
- Focus on delivery, and operational and plausibility research
- Innovate into mobile or malnutrition-tracking progress in real time
- Focus on capacity and leadership development
- Improve and develop new platforms for sharing program experiences, impact and best practices
- Accept trade-offs and balance the risks and benefits of interventions
- Focus on advocacy, supporting policy development and implementation

The Life of an Indian Girl

Disadvantaged before you are born
21% of Indian men and women want more sons than daughters. The sex ratio in children under 7 years is 918 girls for 1000 boys

21%

12% of girls 5–14 years old engaged in child labour

12%

38% reduced risk of child labor if their mother has 8–9 years of education compared with no education

Only 15% of women 15–39 years of age have completed 8–9 years of education

22% of girls 6–24 years old have no education

22%

Educated women have fewer but healthier babies later in life. Their children therefore have a better chance to survive and thrive

1 in 13 girls die before their 5th birthday
A girl has a significantly higher chance of dying before her 5th birthday than a boy

1:13

- **34% of women 15–49 years old** have experienced physical violence and 9% sexual violence
- **1 in 140** women die as a result of pregnancy during their reproductive years [1]
- **The effects of stunting at 2 years of age are largely irreversible.** The impact of stunting is not limited to physical development, having consequences for mental development and educational attainment as well

- **The first 1000 days** from conception to 2 years of age are a 'Critical Window' in a Childs development. Nutrition intervention during this time can have a significant and sustained impact on the child's life [2]
- **Copenhagen Consensus 2008.** Supplementation with vitamin A, to reduce all-cause mortality and zinc to reduce diarrhoea episodes, have been ranked the #1 global development priority. These interventions can have widespread health and economic benefits [3]
- **Infant and young child feeding.** Interventions to improve the rates of exclusive breastfeeding till 6 months of age, and nutrition education on complementary feeding from 6–12 months, have shown to significantly reduce stunting, and improve child survival rates [4]

1.9 mo

Exclusively breastfed for 1.9 months
A girl will be breastfed for 8 weeks less than the average boy

Only 21% of girls 6–23 months of age are fed an optimal complementary diet

Exclusive breast feeding till 6 months and appropriate complementary feeding after 6 months significantly reduces stunting and improves child survival

20%

Vitamin A supplementation
Only 20% of 6–59 month olds received a vitamin A supplement in the past 6 months

Vitamin A supplementation to children under the age of five every four to six months results in a 24% reduction in under-five mortality

1:18

1 in 18 girls die before their 1st birthday

70%

Girls under 5 years:
48% are stunted
19% are wasted
70% are anaemic

Unless stated all data from: International Institute for Population Sciences (IIPS) and Macro International. 2007. National Family Health Survey (NFHS-3), 2005–06: India: Volume I

[1] UNICEF State of the Worlds Children 2012

[2] UNICEF Infant and Young Child Feeding Programming Guide (2011)

[3] Horton et al. (2008) Micronutrient Supplements for Child Survival (Vitamin A and Zinc). Copenhagen Consensus, Best Practice Paper.

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Vitamin A Coverage Among Under-Five Children

A Critical Appraisal of the Vitamin A Supplementation Program in India

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Abstract

Improving the vitamin A status of a population can reduce child mortality by 24%. In India, however, the coverage of vitamin A supplementation (VAS) for children aged 12–59 months is low at 20.2% for one dose in six months. Using the Poverty Reduction Strategy Paper (PRSP) framework, a literature review was undertaken to analyze the factors responsible for low VAS coverage in India. The results show that vitamin A deficiency (VAD) exists across all Indian states, and that the current VAS program suffers from an absence of clear guidelines, which in turn diminishes organizational effectiveness. A lack of community involvement and social accountability also negatively affects the program. Weak implementation strategies have kept India's VAS program from achieving its target coverage.

Introduction

Vitamin A deficiency is the leading cause of preventable childhood blindness and reduced immunity towards infections which results in increased mortality from childhood diseases.[1] According to the World Health Organization (WHO), in 2009, an estimated 190 million preschool children were suffering from biochemical VAD. The prevalence of biochemical VAD among under-five children in India is 62%[1] – among the highest in the world. VAD precipitates the deaths of around 0.3 million children every year in India[2] and the prevalence of VAD in the country is higher than the WHO's limit indicating a public health problem (Bitot's spots: >0.5%, night blindness in children: >1%).[2]

Vitamin A supplementation (VAS) is one of the most cost-effective interventions for reducing childhood mortality,[3] and improving vitamin A status is associated with a 24% reduction in all-cause childhood mortality.[4] VAS is therefore considered a key intervention in reducing the under-five mortality rate (U5MR) and achieving MDG (Millennium Development Goal) 4 of reducing the U5MR by two-thirds by 2015. Effective coverage (70%) with two doses of vitamin A is required in order to achieve a reduction in mortality rates.[6] According to UNICEF, India has been identified as a priority for VAS due to the country's U5MR of >70/1000 live births in 2004.[3] With a slow 34% decline in U5MR since 1990, India's mortality rate for under-fives remains high at 63/1000 live births (2010).[5,6]

Objectives of this paper

To analyze the role and extent of the coverage and performance of India's VAS program, and to examine potential approaches for improving the vitamin A status of under-five children in India.

Methodology

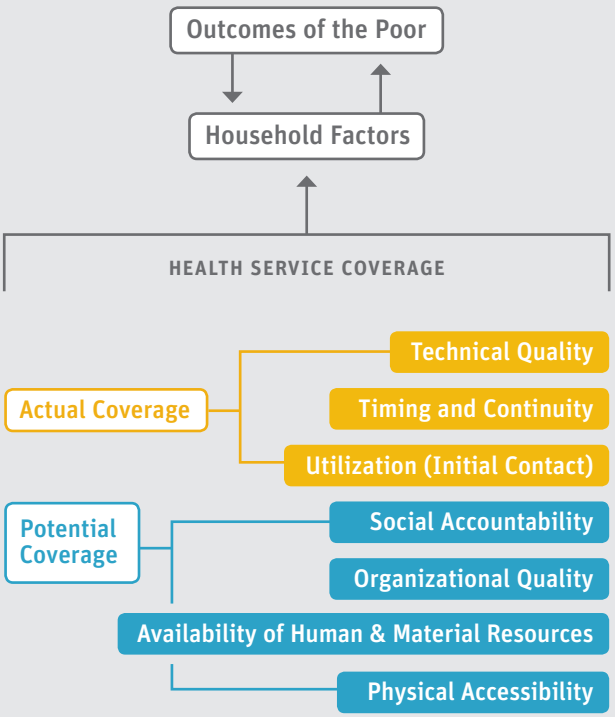
A review of literature from 1991–2012 was carried out using the PRSP model framework **(Figure 1)** for health service coverage evaluation.

Results

India's VAS program was initiated in 1970.[8] At present, the program is integrated alongside the country's Reproductive and Child Health (RCH) program. VAS is provided in syrup form, with 1 mL equivalent to 100,000 IU of vitamin A. The ages of children being supplemented range from nine months to five years, with nine mega-doses of vitamin A provided to under-five children.[3,9]

"Vitamin A supplementation (VAS) is one of the most cost-effective interventions for reducing childhood mortality."

FIGURE 1: Poverty Reduction Strategy Paper (PRSP) framework – Coverage of vitamin A supplementation program



Source:[7]

VAS is carried out through a healthcare delivery system of Primary Health Centers (PHC), Sub-centers (SC) and Integrated Child Development Services (ICDS) centers.[10]

Physical accessibility

Table 1 shows that the average percentage of the population catered to is higher than the required norm. However, Table 1 shows only the percentage of the population covered, not the distribution of health centers in rural areas. Ground realities may be worse in areas where the population is dispersed over inaccessible areas not adequately served by these centers.

> "According to the National Health Policy report of 2002, only 24% of villages in India are equipped with health facilities"

According to the National Health Policy report of 2002, only 24% of villages in India are equipped with health facilities, whereas 88% of the country's healthcare facilities are situated in urban areas.[11] According to the National Rural Health Mission's (NRHM) report in 2009, with an average distance of five kilometers taken as a measure of accessibility to PHCs, it is seen that only 44% of villages had access to a PHC.[13]

Availability of human and material resources

The NRHM's report in 2009 stated that only 48.2% of health centers had adequate staff as per standards.[13] The NRHM has initiated a new cadre of voluntary workers known as Accredited Social Health Activists (ASHAs), who will assist Auxiliary Nurse Midwives (ANMs) or Anganwadi workers (AWWs) with Maternal and Child Health (MCH) interventions including VAS.[14] This initiative could help reduce the workload of the ANMs/AWWs.

Multiple channels of vitamin A supply exist in India.[8] However, the Global Alliance for Vitamin A (GAVA) reported that almost 50% of children were not provided vitamin A due to various constraints including poor supply.[15]

Organizational quality

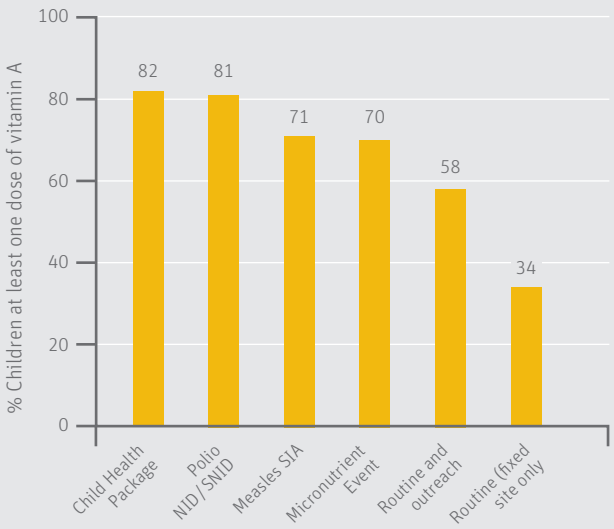
The quality of services is determined by "the extent to which services are responsive to consumer concerns and whether these services are delivered in a way that encourages appropriate utilization of relevant interventions."[7] Program evaluation in fifteen Indian states from 2001–2002 showed a lack of coordination between different program levels. Though providers believed that effective coordination was required, there tended to be disagreements at different levels with regard to the functioning, planning and financial management of the program.[8] An

TABLE 1: Distribution of health centers in India

Health center category	Number of health centers	Population per health center	Required WHO norm (WHO, 2007)
Sub-center	132,000	6,311	3,000–5,000
Primary Health Center	22,000	37,867	20,000–30,000
Community Health Center	7,000	119,012	80,000–120,000

Source: [11,12] (Compiled by author)

FIGURE 2: Mean one-dose vitamin A coverage achieved by distribution strategy, 1999–2004



Source:[3]

Administrative Committee on Coordination/Subcommittee on Nutrition (ACC / SCN) report highlighted weak Information, Education, Communication (IEC) components as having an adverse effect on VAS coverage in India.[16]

In 2001, an incident in Assam – where high doses of vitamin A were administered to children during a campaign – was followed by the deaths of more than twenty children. It was later discovered that UNICEF had provided 5 mL cups for this campaign instead of the more commonly used 2 mL spoons, and that on-ground health providers had not been adequately informed about this change.[a] Due to this oversight, health providers possibly administered 5 mL doses (equivalent to 500,000 IU of vitamin A) to children – well beyond the recommended dose. Vitamin A toxicity caused by overdosing may well have contributed to these child deaths. This unfortunate incident greatly affected the entire public health system, and brought the quality of government health services under question.[17]

VAS is provided free of charge along with routine immunization in public health facilities. Despite this benefit, opportunity costs associated with supplementation, such as transportation and leaving the home or workplace specifically for this purpose, reduce the chances of children receiving VAS.

Social accountability

When consumers are able to exert their influence on the healthcare system, health services are more likely to respond to their demands.[7] A program evaluation survey in fifteen Indian states found that social mobilization was one of the key elements lacking in the program. There was rarely any involvement of community leaders, NGOs or other community stakeholders during program planning or implementation.[8]

The Village Health Committee (VHC), initiated by NRHM, is an approach that aims to build accountability mechanisms for health and nutrition activities at the community level. In a VHC review, gaps identified were: lack of community orientation regarding the VHC; lack of community representation and ownership; and lack of alignment with government health services.[18]

Utilization (initial contact)

Initial contact with health services for VAS occurs when a mother brings in her child for measles vaccination. This is usually when the first dose of vitamin A is administered. Data from the National Family and Health Survey (NFHS) III and UNICEF's coverage evaluation survey, however, show disparities in the coverage between measles and vitamin A. NFHS III reports measles coverage of 58.8%, but that only 25% of children aged 12–35 months had received a dose of vitamin A in the past six months.[19] UNICEF's coverage evaluation survey also reported 71% of children as having received the measles vaccine, but its reported VAS coverage of only 58% for at least one dose among 12–23-month-old children means that one-third of children do not receive VAS.[20]

> "Currently, no Indian state has reached the VAS target of 70% with two annual doses among 6–59-month-old children"

Timing and continuity

Timing and continuity "examines whether beneficiaries receive the necessary number of contacts for services that require repeated interventions"[7] As mentioned, VAS coverage is low at 25–37% (2005)[19,21] for one dose in the past six months. A study by Semba using NFHS III 2005–2006 data showed that VAS coverage decreased with age – where coverage with one dose in the past six months was 45.4% among children aged 12–23 months, this decreased to 16.4% among children aged 36–47 months and then further to 9.4% among children aged 48–59 months. Overall coverage achieved was 20.2% **(Table 2)**. Similarly, UNICEF's coverage evaluation survey showed that though 58% of children aged 12–23 months received one dose of VAS, only 37% had received VAS within the past six months **(Table 2)**.[20]

[a] The court judgment in Assam stated that a stronger dose of vitamin A was introduced due to the replacement of 2 mL spoons with 5 mL cups. Health workers were not trained adequately and administered doses larger than many sick children could tolerate. This showed negligence on the part of the Assam Health Department in the administration of VAS [17]

TABLE 2: U5MR* and coverage of vitamin A supplementation (VAS) by states, India

States / UT	U5MR* (per 1,000 live births) [19]	Coverage of one dose of VAS**		
		Among 12–23 months	Within past 6 6 months (12–23 months)	Within past 6 months (12–59 months) [41] (%)
		[20] (%)		
Uttar Pradesh	96.4	36.5	23.1	5.9
Madhya Pradesh	94.2	66.3	30.5	16.4
Jharkhand	93.0	59.2	37.9	18.5
Orissa	90.6	79.0	43.5	29.7
Chhattisgarh	90.3	57.6	26.6	12.0
Arunachal Pradesh	87.7	45.6	26.0	15.2
Rajasthan	85.4	70.5	65.5	10.5
Assam	85.0	37.6	11.3	11.6
Bihar	84.8	46.9	34.9	28.0
Meghalaya	70.5	44.0	8.9	17.7
Nagaland	64.7	23.3	10.9	6.7
Andhra Pradesh	63.2	65.0	40.0	23.4
Gujarat	60.9	46.0	18.3	15.4
West Bengal	59.6	79.9	50.9	36.5
Tripura	59.2	46.0	17.7	31.6
Uttaranchal	56.8	62.6	32.4	16.2
Karnataka	54.7	62.5	42.0	14.6
Mizoram	52.9	67.2	42.3	42.5
Haryana	52.3	60.6	44.1	11.8
Punjab	52.0	58.5	43.7	17.5
Jammu and Kashmir	51.2	56.5	47.0	19.6
Maharashtra	46.7	68.0	52.9	38.5
Delhi	46.7	30.9	18.1	15.9
Manipur	41.9	23.8	6.9	8.2
Himachal Pradesh	41.5	81.7	60.3	42.9
Sikkim	40.1	78.3	55.5	17.0
Tamil Nadu	35.5	61.0	36.7	39.4
Goa	20.3	80.0	11.6	37.0
Kerala	16.3	72.0	25.1	33.6
Total	**63 (2010)**	**58**	**37**	**20.2**

*U5MR: Under 5 mortality rate /Source: (Compiled by author)

Currently, no Indian state has reached the VAS target of 70% with two annual doses among 6–59-month-old children. A UNICEF report **(Figure 2)** shows that fixed-site VAS administration in India reached a maximum of 34% for one dose of vitamin A, whereas interventions such as National Immunization Days (NIDs) and child health days have achieved a maximum of 82% coverage.[3]

Technical quality

The technical quality of VAS pertains to whether vitamin A doses are administered in accordance with guidelines, and healthcare providers are adequately trained.[7] In India, there exist no program guidelines or operation manuals for VAS. Policy changes are communicated through workshops or training programs.

A program evaluation report on fifteen states from 2001–2002 reported that monitoring and supervision of VAS was mostly absent – and if present, was limited to review meetings and checking of registers. Providers did not have clarity on the components of the program, and the majority of them were unfamiliar with their target clients for VAS.[8] I have personally

TABLE 3: Distribution of states in India according to U5MR*

High-risk states	U5MR* (per thousand live births)	Number of states / Union Territories[1]	Comment
I#	>70	10	VAD** is a public health problem in under-five children which needs immediate action
II	50–70	11	VAD** is a public health problem
III	20–50	7	VAD** likely to exist
IV	<20	1	VAD** may / may not be a problem

*U5MR: Under 5 mortality rate / **VAD: Vitamin A deficiency
Source: (Compiled by author)

#**PRIORITY I:** Uttar Pradesh, Madhya Pradesh, Jharkhand, Orissa, Chhattisgarh, Arunachal Pradesh, Rajasthan, Assam, Bihar, Meghalaya
PRIORITY II: Nagaland, Andhra Pradesh, Gujarat, West Bengal, Tripura, Uttaranchal, Karnataka, Mizoram, Haryana, Punjab, Jammu and Kashmir
PRIORITY III: Maharashtra, Delhi, Manipur, Himachal Pradesh, Sikkim, Tamil Nadu, Goa
PRIORITY IV: Kerala

witnessed the administration of VAS to children with spoons that do not ensure appropriate dosing.

Discussion

Table 2 shows the existing variation in U5MR and coverage of VAS among states, but U5MR is far too high in most states and VAS coverage too low in all states. Since U5MR correlates with VAD[21] and the ultimate objective of VAS is reduction in U5MR, this implies that states with higher U5MR are at higher risk of VAD.

Meanwhile, there has not been significant improvement in U5MR since 1990, which can be explained by a lack of progress in states with U5MR as high as 90–96 / 1000 live births. Therefore, it is necessary to prioritize the improvement of the VAS program by state. Table 3 shows that ten states are at highest risk of child deaths due to VAD. These are the states with U5MR as high as 96 / 1000 live births and very low VAS coverage, not exceeding 25%.

Although many elements influence VAS coverage, some factors come up as important determinants. To a large extent, low VAS coverage results from relying solely on routine services for administration of VAS. The decrease of coverage with age indicates the inability to cover children for subsequent doses through the fixed health facility approach. Increasing the number and coverage of health facilities and providing additional resources may improve coverage of the first two doses with Expanded Program on Immunization (EPI) activities, but what of subsequent doses? With no further efforts made by the health services to reach children, subsequent doses may not be taken.

> "There exists a wide network of Integrated Child Development Services (ICDS) centers which might be an effective channel for delivering VAS in both rural and urban areas"

TABLE 4: Recommended implementation of vitamin A supplementation (VAS) program in order of priority

PHASE (in years)	Strategy
I (3–4)	Routine immunization and biannual administration of vitamin A through ICDS* centers
II (3–4)	Child health days for one week twice yearly, including other child health interventions like growth monitoring, nutrition education and immunization using ICDS* centers and temporary posts in inaccessible areas

*ICDS: Integrated Child Development Services / Source: (Compiled by author)

Recommendations

At policy level:

- India's VAS program needs revision, which can be implemented in phases (Table 4).
- VAS program guidelines must be formulated.
- Vitamin A capsules (VAC) should be used in place of vitamin A syrup.

At implementation level:

- Involvement in program implementation and coordination of activities is required from stakeholders such as community representatives, NGOs, and women's groups.
- AWWs/ANMs, ASHAs and community volunteers are required to:
  - Trace those who are overlooked or have dropped out from the program;
  - Organize outreach sessions; and
  - Arrange Information, Education, Communication (IEC) activities.
- Regular monitoring is required for outreach immunization sessions.
- Training of health staff is essential.

Research

- Operational research should be carried out in each state to assess the strengths and weaknesses of different distribution strategies.

There exists a wide network of Integrated Child Development Services (ICDS) centers which might be an effective channel for delivering VAS in both rural and urban areas. This would also allow beneficiaries from the lowest quintile access to health services at minimal opportunity costs. The WHO has suggested that if VAS coverage levels through routine activities fall below 80%, this indicates a need for supplementary coverage activities.[22]

The lack of program guidelines also affects the quality of VAS services and is the primary reason for the lack of coordination between different implementation levels. The absence of training modules for VAS affects the technical quality of the program, as do poor supervision and monitoring. For example, in comparison to syrup, vitamin A capsules are easier to administer, more hygienic and provide more accurate doses.[23] Adopting the use of capsules over syrup would therefore increase the effectiveness of the program.

The lack of social mobilization efforts within the program reveals a dearth of accountability measures. Structures for accountability are in place within the establishment of VHCs, but are not put into action. The answerability of health providers to the community, and the enforceability of law in the event of non-adherence, is missing.[24]

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Using Plant Foods Rich in β-Carotene to Combat Vitamin A Deficiency

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Key messages

- New approaches of breeding staple food plants that can reach levels of targeted provitamin A content through natural hybrid or genetic bio-fortifications were successful.
- The efficacy and effectiveness of consuming newly biofortified staple plant foods with provitamin A carotenoids demonstrated the improvement of vitamin A status in certain populations.
- It is optimistic that plant foods including these biofortified staple foods will help to combat vitamin A deficiency (VAD).

"There is a chronic shortage of dietary vitamin A resulting in vitamin A deficiency (VAD). Vitamin A can be obtained from foods containing preformed vitamin A from animal origin and/or from foods rich in provitamin A carotenoids, mainly β-carotene, from plants"

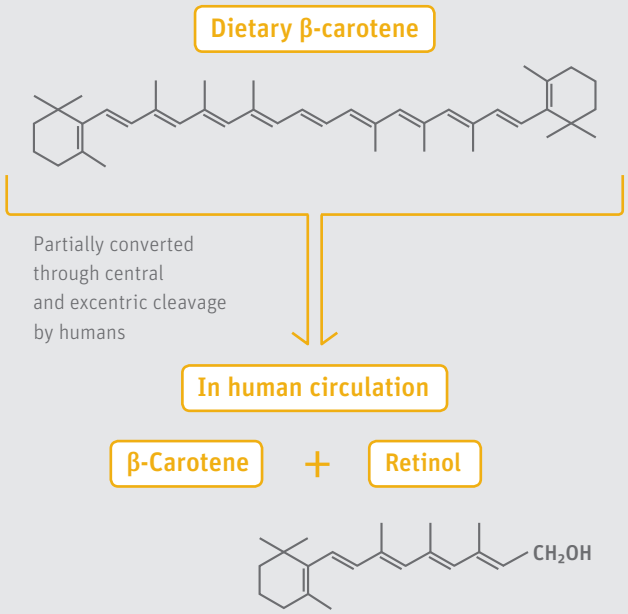
Introduction

Plant and algae are capable of synthesizing β-carotene. However, humans and animals are not capable of synthesizing β-carotene. But they are capable of converting β-carotene absorbed from their diets to vitamin A. The difference between humans and animals (white-fat mammals) in digesting or processing dietary β-carotene is that humans can absorb intact β-carotene (detected β-carotene in human circulation) **(Figure 1)** whereas most white-fat animals cannot.[1] Vitamin A formed from plant β-carotene eaten by animals, in addition to meeting their daily needs, is stored in animal tissues and organs (mainly in liver, egg yolk, milk, etc.). Through the intake of these foods originating from animals, humans can easily absorb their vitamin A content (preformed vitamin A). In addition, they still obtain sufficient vitamin A needs of about 0.5–0.7 mg per day.[2] About 2–3 eggs or 50–100 g of butter or 10 g of liver per day will be enough to satisfy the daily need for vitamin A (preformed). However, foods from animal origins are not always available or affordable for millions of people in various parts of the world. Therefore, plant foods, mainly dark-green / yellow vegetables or orange colored fruits rich in provitamin A carotenoids, containing mainly β-carotene, are usually the source of vitamin A for these populations. These populations who rely on provitamin A carotenoids as their sole vitamin A source must convert the provitamin A in their diets into vitamin A. If the population cannot effectively convert dietary β-carotene to vitamin A, or if they cannot obtain a sufficient amount of this to meet their daily dietary needs, the chronic lack will result in VAD.

Currently, it is estimated that VAD is affecting 190 million preschool age children worldwide[3] mainly in southeastern Asia and sub-Saharan African countries. Global efforts to control VAD can be traced back to the 1980s, when the strategies proposed were; **1)** dietary diversification; **2)** food fortification with vitamin A; and **3)** periodic administration of vitamin A supplements to control new cases of nutrition-related xerophthalmia; this was due to VAD in 8-10 million children each year.[4] In 2002, VAD related xerophthalmia was then estimated to having been reduced, affecting just 4.4 million children.[5] This was mainly attributed to the periodic administration of vitamin A supplementation.

"A long term and sustainable approach to combating VAD is through the use of affordable, accessible, and effective diets in people's daily meals"

FIGURE 1: Conversion of dietary β-carotene to retinol by humans.



"The difference between humans and animals (white-fat mammals) in digesting or processing dietary β-carotene is that humans can absorb intact β-carotene whereas most white-fat animals cannot"

Given the fact that chronic shortages of vitamin A in diets will result in VAD, a long term and sustainable approach to combating VAD is through the use of affordable, accessible, and effective diets in people's daily meals. Both preformed vitamin A (in animal food products) and the provitamin A carotenoids (mainly in β-carotene rich plant foods) can provide vitamin A. However, the efficacy and effectiveness of β-carotene (in vegetables and fruits) providing vitamin A has been in question due to complex factors regarding the absorption of β-carotene and it's conversion into vitamin A. [6,7] In order to develop a long term and sustainable approach to combat VAD and other micronutrient deficiencies, a new concept was proposed in the 1990s to breed staple food crops through bio-fortification with high-density micronutrients. These included iron, zinc, provitamin A, and other micronutrients.[8,9] This approach creates staple food crops that can provide not only energy and protein, but also more micronutrients. In recent years, breeding staple food plants has shown promise in reaching the content levels of targeted provitamin A through natural hybrid or genetic bio-fortifications. These staple crops are: orange-fleshed sweet potatoes, high β-carotene yellow maize, Golden Rice, β-carotene biofortified cassava, yellow endosperm sorghum, high β-carotene soybeans, and peanuts.

Studies on using plant foods to provide vitamin A

Fruits and vegetables

There are challenges in studying the vitamin A activities of provitamin A carotenoids in plant food diets fed to humans. The first challenge is that plasma β-carotene concentration cannot be altered by eating a meal containing up to 6 mg of β-carotene in a food matrix. [10,11] Therefore, because of the insensitivity of the blood response, 6 mg doses of unlabeled β-carotene cannot be used to study its absorption or conversion. The second challenge is that the vitamin A formed from the conversion of β-carotene cannot be estimated accurately in well-nourished humans by assessing changes in concentration of circulating retinol after supplementation with β-carotene. This is due to the inability to distinguish newly formed retinol from the retinol derived from body reserves, which is because blood retinol concentrations are homeostatically controlled in well-nourished individuals.

Investigation into populations that normally have a low vitamin A intake have reported blood retinol responses to acute or chronic β-carotene supplements.[11,12] Changes in serum retinol levels were seen in vitamin A deficient (~ 0.7 µmol / L) anemic school children aged 7–11 years,[13] when fed one of four supplements: diet 1, 556 µg RE / day (RE=retinol equivalents) from retinol-rich foods (n = 48); diet 2, 509 µg RE / day from fruits (n = 49); diet 3, 684 µg RE / day from vegetables (n = 45); or diet 4, 44 µg RE / day from low-retinol and low-carotene foods (n = 46). The supplements were fed to the school children 6 days per week for 9 weeks. The changes in serum retinol concentration were assessed to determine the relative conversion efficiency of β-carotene to vitamin A from vegetables or fruits to vitamin A status of the group fed food rich in preformed vitamin A (including egg, chicken liver, fortified margarine and fortified chocolate milk). Those consuming fruit (diet 2) or vegetables (diet 3) showed increases of 0.12 µmol / L and 0.07 µmol / L of circulating vitamin A, respectively. Serum retinol concentration of the group consuming foods rich in preformed vitamin A (diet 1) showed an increase of 0.23 µmol / L. The relative mean conversion factor of vegetable β-carotene into retinol was calculated weight-wise as 26:1 and that of β-carotene from orange fruit as 12:1. A similar approach[14] showed that, for breastfeeding women, the conversion factors of β-carotene into retinol were, weight-wise, 28:1 for green leafy vegetables and 12:1 for orange or yellow fruit.

A later study[15] was conducted to determine whether plant carotenoids could sustain or improve vitamin A nutrition in Chinese children with limited access to green-yellow vegetables during the fall/winter season. Stable isotope dilution techniques were used to evaluate the whole body stores of vitamin A before and after the intervention. For 5 days /week for 10 weeks, 22 children were provided ≈238 g green / yellow vegetables /day (total of 206 mg of calculated all-trans β-carotene for 10 weeks) and 34 g light-colored vegetables/day. Nineteen children maintained their customary dietary intake, which included 56 g green / yellow vegetables /day and 224 g light-colored vegetables / day. Through the use of *octa-deuterated* and *tetra-deuterated* vitamin A given before and after the interventions (isotope dilution tests), their whole body stores of vitamin A were determined. The results showed that carotenoid nutrition improved after consumption of green / yellow vegetables. Serum concentrations of retinol were sustained in the group fed green / yellow vegetables but decreased in the group fed light-colored vegetables ($P < 0.01$). The isotope-dilution tests confirmed that total-body vitamin A stores were sustained in the group fed green/yellow vegetables, but it decreased, on average, to 7.7 mg retinol per child in the group fed light-colored vegetables ($P < 0.06$). That is, the additional 206 mg of β-carotene prevented a loss of 7.7 mg retinol. For this observation, an estimated vitamin A equivalence of 27 to 1, i.e. 27 mg (or any weight unit) of β-carotene from vegetable was nutritionally equivalent to 1 mg of retinol (with a range of 19 to 1 to 48 to 1 by weight).

> "Serum concentrations of retinol were sustained in the group fed green/yellow vegetables but decreased in the group fed light-colored vegetables"

These early studies showed that green/yellow vegetables and orange colored fruits can provide vitamin A nutrition with lower conversion efficiency than 6 to 1 or 12 to 1 by weight[16] as we had previously expected. During this period, a novel and practical concept of biofortification for improving the nutritive value of staple crops was developed and eventually became a multiple disciplinary effort including plant science, genetics, nutrition, food science, and economics.[17–19] The researchers of academia, USDA, Gates Foundation, Harvest Plus, and USAID, worked together on the biofortification of staple food crops to breed some for better nutrition and for alleviating micronutrient deficiency. These efforts made a meaningful contribution to successful progress.

Recent advancements

The current research studies on using plant provitamin A carotenoids in humans have shown promising results. Here are a few examples of these achievements:

- Use of orange-flesh sweet potato (OFSP) to prevent vitamin A malnutrition has been used in a few feeding trials in some countries in Africa and Asia.
- Through conventional breeding, β-carotene contents in the OFSP can reach as high as 194 µg/g.[20] In fact, each serving of 125 g per day for 53 school days to 5–10 years old children in Durban, South Africa showed significant improvement of vitamin A status.[21]
- A study conducted in adults of Bangladesh,[22] evaluated the vitamin A equivalency of sweet potato. Researchers found that the adults who consumed 750 µg RE as sweet potatoes per day for 60 days, the estimated vitamin A equivalency factors (β-carotene to retinol, by weight) were at 13 to 1.
- In rural Mozambique,[23] a study used OFSP rich in β-carotene found that it was well accepted by young children. The study was started on 13–17.4 month old children and lasted for 2 years through integrated agriculture and nutritional intervention in producing OFSP in households participating in the study, and increased the intake of it for the household and the children. As compared to the controlled households, the intervention children (from n = 498 households) were more likely than children (from n = 243 households) to eat OFSP at least 3 days in a week. At the end of the 2-year study (55% vs. 8% households, $p<0.001$) the provitamin A intakes of the intervention children were much higher than those of the control group children (426 µg vs. 56 µg retinol activity equivalents (RAE), $p<0.001$). The serum concentration of vitamin A increased significantly in children in the intervention households (0.1 µmol/L, $p<0.001$), as compared to the control group (no change). This field study further confirmed the effectiveness of using OFSP in daily meals to prevent vitamin A deficiency.

Maize

Maize biofortified with β-carotene (high β-carotene yellow maize) was recently studied in the US and in Zimbabwe. From the study in the US, women[24] showed that the vitamin A value of maize β-carotene was 6.45 to 1 (by wt) when consumed by six women volunteers and evaluated up to 9 h after the β-carotene dose. The study of the Zimbabwean men[25] showed that the vitamin A values of maize β-carotene were 3.2 to 1 by wt when consumed by eight male volunteers and evaluated up to 28 days after one meal of the high β-carotene yellow maize porridge known locally as *sadza*.

The study conducted in the US[24] was of six healthy women who each consumed three 250 g portions of maize porridge in

random order separated by ≥2 weeks as β-carotene-biofortified maize porridge containing 527 µg (0.98 µmol) total β-carotene, or as white maize porridge with a β-carotene reference dose containing 595 µg (1.11 µmol) of added β-carotene, or white maize porridge with a vitamin A reference dose containing 286 µg RAE (1.0 µmol) added retinyl palmitate. Blood samples were collected over 9 h. Retinyl palmitate was analyzed in plasma triacylglycerol–rich lipoprotein (TRL) fractions by HPLC by coulometric array electrochemical detection. The results showed that when compared with the response of retinyl palmitate in the TRL fractions after ingestion of the β-carotene–biofortified maize porridge (or the white maize porridge with the β-carotene reference dose, and the white maize porridge with the vitamin A reference dose) on average, 6.48 ± 3.51 µg (mean ± SD) of the β-carotene in β-carotene-biofortified maize porridge and 2.34 ± 1.61 µg of the β-carotene in the reference dose were each equivalent to 1 µg retinol.

The study conducted in Zimbabwe[25] was done on eight healthy men who each consumed 300 g portions of *sadza* containing 1.2 mg β-carotene and 20.5 g fat. When 1 mg [$^{13}C_{10}$] retinyl acetate in a 0.5 g corn oil capsule and 300 g white maize porridge with 20.5 g fat as a reference dose was used, the conversion factor of yellow maize β-carotene to retinol by weight was 3.2 ± 1.5 to 1 (with a range of 1.5–5.3 to 1 by weight). Thus, 300 g cooked yellow maize containing 1.2 mg β-carotene that was consumed with 20.5 g fat showed the same vitamin A activity as 0.38 mg retinol and provided 40–50% of the adult vitamin A 'recommended dietary allowance.'

These efficacy studies show evidence that high β-carotene yellow maize is a potentially good source of vitamin A. These results will need further evaluation through use of the biofortified yellow maize in daily meals in order to determine their effectiveness in improving vitamin A nutrition by the population eating maize (currently mainly white maize) as their staple foods.

Golden Rice

Rice biofortified with β-carotene (Golden Rice) through genetic engineering contains up to 30–35 µg β-carotene per gram of dry rice.[26] Golden Rice was studied for its efficacy in providing vitamin A in US adults[27] and in Chinese children.[28] The study of the US adults showed that the vitamin A value of Golden Rice β-carotene was 3.6 to 1 by wt when consumed by five US (three women and two men) adult volunteers and evaluated the blood enrichment of the retinol formed from the Golden Rice β-carotene up to 36 days after the intake of one Golden Rice meal at the beginning of the study. The study of Chinese school children (6–8 years) with normal or marginal vitamin A status showed that the vitamin A value of Golden Rice β-carotene was 2.3 to 1 by wt when consumed by child volunteers and evaluated up to 21 days after an intake of one Golden Rice meal at the beginning of the study. For these studies, Golden Rice plants were grown hydroponically with heavy water (deuterium oxide) to generate deuterium-labeled [^{2}H] β-carotene in the rice grains, which is, intrinsically labeled rice β-carotene with stable isotope deuterium.

In the US adults' study,[27] Golden Rice servings of 65–98 g (130–200 g cooked rice) containing 0.99–1.53 mg β-carotene (intrinsically deuterium labeled) were fed to healthy adult volunteers with 10 g butter. A reference dose of [$^{13}C_{10}$] retinyl acetate (0.4–1.0 mg) in oil was given to each volunteer 1 week before ingestion of the Golden Rice dose. Blood samples were collected over 36 days. The study results showed that the conversion factor of Golden Rice β-carotene to retinol is 3.6 to 1 with a range of 1.9–6.4 to 1 by wt. Therefore, Golden Rice β-carotene is effectively converted to vitamin A in humans.

A further study was conducted to compare the vitamin A value of β-carotene in Golden Rice and in spinach with that of pure β-carotene in oil when consumed by children.[28] During the study, the children (n = 68; age 6–8 years) were randomly assigned to consume Golden Rice or spinach (both grown in a nutrient solution containing 23 atom% $^{2}H_2O$) or [$^{2}H_8$] β-carotene in an oil capsule. The Golden Rice and spinach β-carotene were enriched with deuterium (^{2}H) with the highest abundance molecular mass (M) at Mβ-C+$^{2}H_{10}$. [$^{13}C_{10}$] Retinyl acetate in an oil capsule was administered as a reference dose. Using the response to the dose of [$^{13}C_{10}$] retinyl acetate (0.5 mg) as a reference, the study results showed that the conversions of pure β-carotene (0.5 mg), Golden Rice β-carotene (0.6 mg), and spinach β-carotene (1.4 mg) to retinol were 2.0, 2.3, and 7.5 to 1 by wt, respectively. From these results, we can see that β-carotene in Golden Rice is as effective as pure β-carotene in oil and better than that of spinach in the provision of vitamin A to children. Also, from these results we can expect that a bowl of ~100 to 150 g cooked Golden Rice (50 g dry weight) can provide ~ 60% of the Chinese 'recommended nutrient intake' of vitamin A for 6–8-years-old children.

These studies on vitamin A values of Golden Rice β-carotene also demonstrated that children can convert dietary β-carotene more effectively than adults. This is similar to the efficacy studies on the conversion of spinach β-carotene to vitamin A, that is, 7.5 to 1 (by wt) by children as compared to the 21 to 1 (by wt) by adults.[29]

Cassava

Cassava biofortified with β-carotene was developed through both plant breeding and genetic modification.[30,31] Biofortified cassava (from plant breeding) has been evaluated in human studies to quantify the vitamin A equivalence of the cassava β-carotene to vitamin A.[32] During the research trial, a single serving of cassava

porridge was given to women (n = 8), each consumed in random order, three cassava porridge doses (220 g each) containing 40 g cassava flour: dose 1, biofortified cassava porridge (1097.5 µg β-carotene); dose 2, white cassava porridge with β-carotene reference dose (537.6 µg added β-carotene); dose 3, white cassava porridge with vitamin A reference dose (285.6 µg added retinol). Blood samples were collected over 9 h. Retinyl palmitate was analyzed in triacylglycerol-rich lipoprotein fractions by HPLC with electrochemical detection. Areas under the curve (AUC) for retinyl palmitate (nmol·h) were 213.0 ± 59.7, 141.5 ± 46.3, and 159.0 ± 81.6 after ingestion of biofortified cassava porridge, white cassava porridge with β-carotene reference dose, and the same with vitamin A instead, respectively. The vitamin A equivalence of the β-carotene in β-carotene-biofortified cassava was 2.8 ± 1.8 to 1 (by wt); the vitamin A equivalence of the β-carotene reference dose was 2.1 ± 0.8 to 1 (by wt).

Research on biofortified staple food crops is progressing at various stages. The high β-carotene soybean has reached as high as 200 µg β-carotene per gram of dry soybean. Sorghum has been successfully initiated the biofortification with β-carotene to produce high yellow endosperm sorghum.[33] Biofortification of ground nuts is undergoing investigation.

Clearly, dark green/yellow vegetables and orange colored fruits are rich in β-carotene and other provitamin A carotenoids. However, the conversion efficiencies were generally lower than we expected with a range from 10 to 1 to 28 to 1 **(Table 1)**. Therefore, staple food crops biofortified with β-carotene are more effective sources in providing vitamin A to humans.

Understanding absorption and conversion of dietary β-carotene to vitamin A in humans

All these studies showed that the efficacy of dietary β-carotene to provide vitamin A is dependent on many factors, including but not limited to, the food matrix with which the β-carotene is associated, the host status of the consumers ie; age, nutritional status.

In general, the mnemonic SLAMENGHI (S, the species of carotenoid; L, molecular linkage; A, the amount of carotenoids consumed in a meal; M, the matrix in which the carotenoid is incorporated; E, effectors of absorption; N, the nutrient status of the host; G, genetic factors; H, host related factors; and I, mathematical interactions of factors affecting bioavailability and bioconversion) has been proposed to cover all the possible influences on bioefficacy.[34]

Furthermore, food processing can also affect the carotenoids or vitamin A value of foods. This was evaluated in a study using an extrinsic reference method[35] to estimate the mass of carotenes and vitamin A derived from various preparations made from the same lot of carrots. By using a repeated-measures design, nine healthy adult subjects consumed test meals of either carrot puree (commercial baby food) or boiled-mashed carrots on separate days; in the meantime, six of the subjects also consumed a test meal of raw-grated carrots. The study results showed that processing could significantly improve bioavailability of carrot carotenes, and in some cases, influence the carotene value (through intestinal absorption) more than the intrinsic vitamin A value (conversion from absorbed carotene).

Stability of carotenoids in plant foods

Compared to the dark-green/yellow vegetables and orange colored fruits, the shelf life of staple food in the stock is much longer. However, the carotenoids in the staple crops are not as stable as we thought. The nutrient content of carotenoids was subject to loss along with storage time. Therefore, more research on the stabilization of provitamin A carotenoids in staple crops will be needed. Scientists[36] recently discovered the *Orange* gene could enhance carotenoid accumulation and stability during post-harvest storage of potato tubers. These results showed that it is possible through new technology to promote and/or stabilize provitamin A accumulation during plant growth and post-harvest storage.

Future direction

Recent human application studies have shown the positive potential of using staple food plants biofortified with provitamin A carotenoids to provide vitamin A. This diversification of the dietary sources through agricultural technologies to enrich nutrients in various staple food crops is beneficial for better health, especially for combating vitamin A deficiency in various areas in the world. The agricultural development will continue to enrich the plant foods to reach the target levels of provitamin A carotenoids for the nutritionally significant benefits when consuming dietary levels of plant food nutrients.

The new lines of the biofortified foods will need acceptance studies and evaluations of the absorption and conversion by targeted populations. Acceptance studies will be needed to evaluate the willingness to consume the biofortified foods. Furthermore, efficacy studies will provide quantitative information on recommendations and eventually for the design of the effectiveness studies on various populations. Ultimately, the effectiveness studies of various populations by implementing the new biofortified staple food crops to the daily meals will evaluate the consequences of these novel and diversified new plant foods. Also, the storage stability of the biofortified staple foods will need new technology to minimize degradation along with the length of storage time until the next harvest season. Eventually these locally planted and harvested biofortified staple plant foods will effectively combat vitamin A deficiency in various areas around the globe where vitamin A deficiency is still a valid problem.

TABLE 1: Vitamin A equivalence of dietary plant β-carotene to retinol in humans

Food Matrix	Dose & subjects	Conversion factor by weight (range)	References
Spinach 	Cooked pureed spinach (grown hydroponically with ~25% heavy water) contained 11 mg β-C; 3 mg $^{2}H_{8}$ vitamin A taken as reference dose US adults, n=14	21 : 1 (11 to 47 : 1)	15
Carrots 	Cooked pureed carrots (grown hydroponically with ~25% heavy water) contained 10 mg β-C; 3 mg $^{2}H_{8}$ vitamin A taken as reference dose US adults, n=7	15 : 1 (8 to 25 : 1)	15
Raw Carrots 	Subject fed on raw carrot (containing 9.8 µmol β-carotene and 5.2 pmol α-carotene) and 2 mg (7 µmol) $^{2}H_{4}$-labelled retinyl acetate in a test meal with 20 g fat. US adult, n=1. Evaluated using postprandial chylomicron method.	13 : 1	37
Orange fleshed sweet potato (OFSP) 	Mean changes of total body stores of vitamin A before and after a 60 day intervention in adult men compared with the mean changes in the retinyl palmitate group: Sweet potato, 750 µg retinol equivalent (RE)	13 : 1	22
Indian spinach 	Indian spinach, 750 µg RE β-carotene capsule, 750 µg RE Retinyl palmitate, 750 µg RE Bangladesh men, n=14	10 : 1 6 : 1	22
Golden Rice 	Cooked Golden Rice (GR) (grown hydroponically with ~25% heavy water) contained 1–1.5 mg β-C. 0.5 – 1 mg $^{13}C_{10}$ vitamin A was taken as reference dose. US adults, n=5	3.6 : 1 (2.0 to 6.4 : 1)	27
Cooked Golden Rice **Spinach** 	Vitamin A value of β-C in GR, spinach and pure β-C in oil was evaluated using intrinsically labeled (hydroponic w/heavy water) GR (0.6 mg β-C), n=23; spinach (1.4 mg β-C), n=22; or [$^{2}H_{8}$] β-C in an oil capsule, n=23. 0.5 mg [$^{13}C_{10}$] retinyl acetate was taken as a reference. Chinese school children, 6–8-y-old	2.3 : 1 7.5 : 1 2.0 : 1	28

β-C: β-carotene

Food Matrix	Dose & subjects	Conversion factor by weight (range)	References
Yellow maize 	Yellow maize porridge, containing 0.5 mg β-C	6.5 : 1	24
	White maize added with 0.6 mg β-C	2.3 : 1	
	as a reference; White maize with 0.3 retinol		
	activity equivalents as a control.		
	US adults, n=6 for each dose.		
	Evaluate by the measurement of the		
	plasma triacylglycerol–rich lipoprotein		
	fractions responses after taking study doses.		
	High β-C-containing yellow maize was	3.2 : 1	25
	grown in a hydroponic medium with		
	heavy water during grain development.		
	Subjects consumed 300 g cooked yellow		
	maize porridge containing 1.2 mg β-C.		
	1 mg [$^{13}C_{10}$]retinyl acetate was taken as		
	a reference dose. Zimbabwean men, n=8		
Yellow cassava 	β-C-biofortified cassava porridge:	2.8 : 1	32
	Biofortified cassava porridge, 1 mg β-C;	2.1 : 1	
	White cassava porridge with β-C		
	reference dose (~0.5 mg added β-C)		
	White cassava porridge with vitamin A		
	reference dose (~0.3 mg added retinol		
	activity equivalent).		
	US adults, n=8 for each study dose.		

β-C: β-carotene

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Adequate Nutrient Intakes for Infancy

Part 2: Complementary Food from 6 to 24 Months

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Key messages

- Sub-optimal breastfeeding, especially non-exclusive breastfeeding in the first six months of life, results in 1.4 million child deaths in the world's developing regions.
- WHO recommends that breastfeeding should be exclusive for the first six months of life and should continue until two years or more.
- Breastfeeding protects against gastrointestinal disease and diarrhea.
- Complementary foods should be gradually introduced at six months.
- Complementary foods should not displace breast milk, but should supplement the child's diet.
- Most home-produced complementary foods have low but adequate energy density to support growth.
- Home-produced complementary foods often contain insufficient micronutrients to meet the child's requirements.
- The WHO recommends complementary foods should be fed with a spoon or other implement but not a bottle, and should not be marketed inappropriately.
- Commercially produced complementary foods may be used to increase micronutrient intakes but the volume should conform to local guidelines to avoid displacing breast milk intake.

Introduction

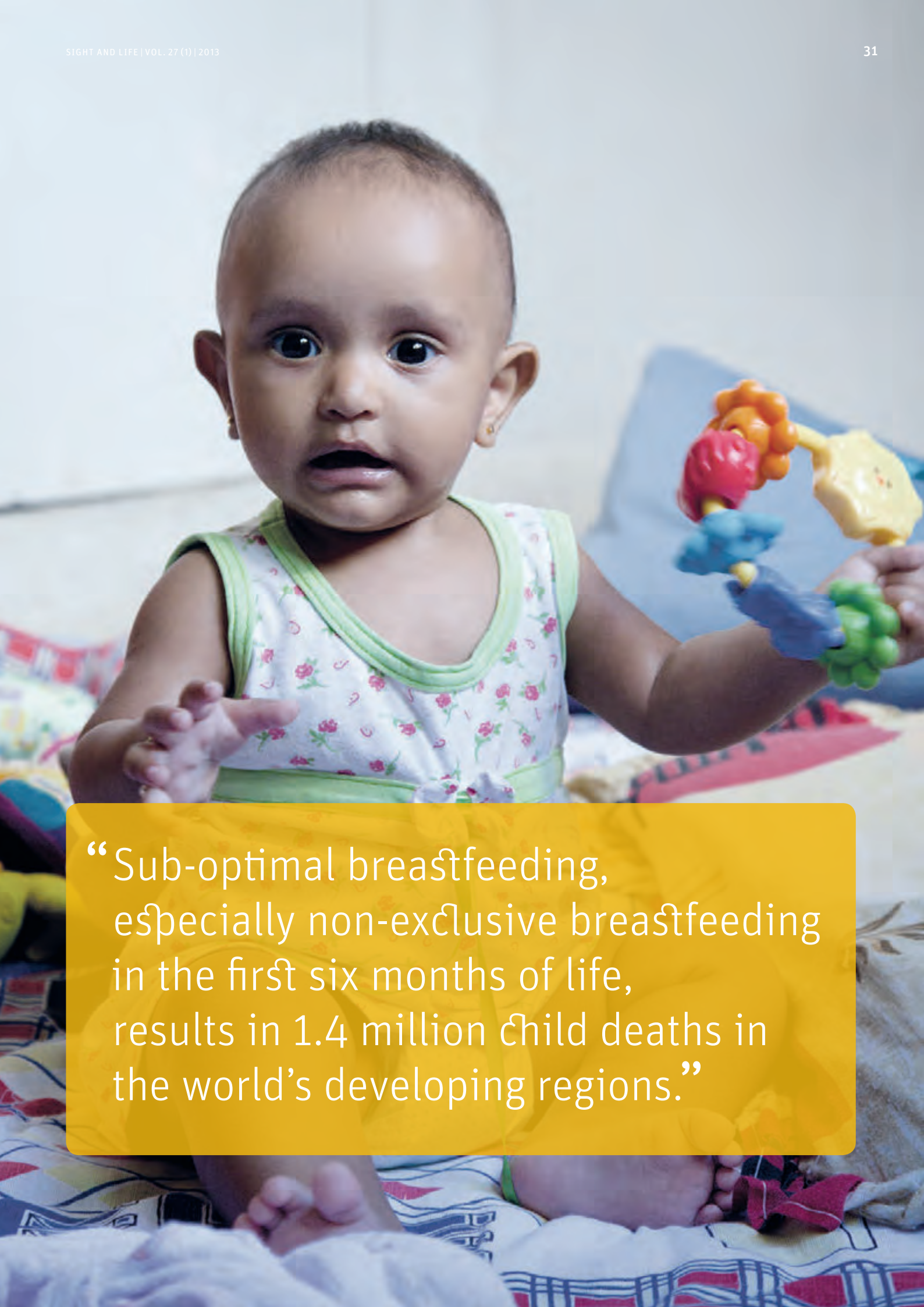
Sub-optimal breastfeeding, especially non-exclusive breastfeeding in the first six months of life, results in 1.4 million deaths and 10% of the disease burden in children younger than five years old.[1] The World Health Organization (WHO) recommends that breastfeeding should be exclusive for the first six months of life[2] and thereafter, should continue with the gradual introduction of safe, adequate complementary food.[3]

In the previous issue, I described how Adequate Intakes (AI) of nutrients for full-term infant nutrition were derived from the nutrient concentrations in the milk of healthy, well-fed mothers between 2–6 months of lactation who produced on average a volume of 780 mL of milk / day.[4,5] For an infant to obtain AI of nutrients, the WHO recommends exclusive breastfeeding for the first six months of life.[2] Unfortunately, although mothers in developing countries can produce the necessary volume of milk for the breastfed infant,[6] there is considerable evidence that both the required volume and nutrient concentration are not obtained in many settings. Moreover, many infants are born with low birth weights and / or are delivered pre-term, and are thus unlikely to possess the nutrient stores that a term infant would.[7] Exclusive breastfeeding for the first six months of an infant's life is sadly uncommon in many settings and there is evidence that maternal malnutrition impairs milk quality. This highlights the need for ongoing interventions that promote and protect breastfeeding, and raise awareness regarding the nutrient status of pregnant and breastfeeding mothers and women of childbearing age.

There is widespread evidence of growth faltering[8] by just three months of life, and there are frequent reports of micronutrient malnutrition during the first six months of life that we cannot neglect to consider.[4] In this issue, however, I look at the importance of continued breastfeeding during the subsequent period of infancy from six months through to 24 months of age, and at some of the attempts being made to combat malnutrition in this age group.

Sickness in infancy

From six months of age, safe, nutrient-dense complementary foods should be introduced but breastfeeding should continue, especially because amongst other benefits, it provides a safe



"Sub-optimal breastfeeding, especially non-exclusive breastfeeding in the first six months of life, results in 1.4 million child deaths in the world's developing regions."

TABLE 1: Prevalence of sick-days per year in breastfed and formula-fed infants of upper-middle-class, well-educated American women.[#,##]

Illness	Sick-days / year			
	Age 0 – 12 months		Age 12 – 24 months	
	Breastfed	Formula-fed	Breastfed	Formula-fed
Respiratory illnesses	62.3	59.6	61.9	72.9
Diarrhea	2.6	6.3	10.7	11.2
Otitis media	10.0[a]	15.8[b]	11.1	17.3
Other illnesses	3.4	1.8	5.2	4.5
Total	**78.3**	**83.5**	**88.9**	**99.4**

Data from reference[11] with permission.

[#]In the breastfeeding group, human milk was the main form of nutrition for the first 12 months and for a substantial period from 12–24 months. Seventy-three infants were exclusively breastfed for three months but 27 dropped out between 3 –12 months, leaving 45 infants who were studied throughout. Mothers in the formula-feeding group had either decided prenatally not to breastfeed (n=11), or to terminate by three months (n=30).

[##]In the breastfed group, there were significantly fewer episodes of diarrhea and otitis media in the first 12 months, but the number of sick days only differed for otitis media. ([a,b])

TABLE 2: Calculated energy, iron, zinc and anti-nutrient content (per 100 g as eaten) of selected cereal and root- or tuber-based complementary foods.[#]

Complementary food				
Composition	Ratio by weight	Energy (kcal)	Thiamin (mg)	Riboflavin (mg)
Unrefined maize flour: cow peas: ground nuts: water[a]	17:10:5:68	116	0.17	0.05
Unrefined maize flour: soya flour: sorghum: ground nuts: water[a]	20:3:1:4:72	105	0.11	0.04
Refined maize flour: soya flour: water[a]	22:6:72	103	0.06	0.02
Wheat: sorghum: brown sugar: oil: water[b]	15:2:12:3:68	127	0.05	0.01
Rice: kidney beans: roasted sesame: sugar: water[c]	4:1:7:1:87	63	0.08	0.02
Rice: mung beans: ghee: water[b]	30:7:4:59	161	0.10	0.03
Rice: sorghum: brown sugar: oil: water[b]	18:3:12:4:63	115	0.07	0.02
Rice: dried fish: ground nuts: water[d]	20:3:6:71	104	0.09	0.03
Banana flour: ground nuts: sugar: water[c]	13:18:24:45	206	0.14	0.06
Sweet potato: egg: dried skim milk: oil: sugar: water[e]	47:28:6:3:3:13	160	0.09	0.20
Sago flour: wheat: brown sugar: oil: water[e]	16:1:10:4:69	133	0.00	0.00

[#]Data from reference[18] (with permission).

liquid and possesses anti-infective properties. Newborn infants are highly susceptible to infection during early life, which is in large part due to immaturity of the immune system and the need of the infant to acquire information on its external pathogenic environment.[9] Infants spend a considerable amount of time sick during the first 24 months of life. In The Gambia this was recently reported to vary between 30–40% during three-month periods in the first 12 months, i.e., 110–146 days per year.[10] This may seem to be too many days of sickness. However, a carefully controlled study of the infants of upper-middle-class, well-educated American mothers also reported 78–99 sick days per year **(Table 1)**.[11]

In the Gambian study, breastfeeding is the normal practice for all mothers, but from 2–3 months of age, infants do receive home-produced complementary foods made with potentially contaminated water. This period of life coincides with the onset of growth faltering.[12,13] In contrast, infants in the American study were divided into two groups: those receiving predominantly breast milk for the first 12 months and most of the period from 12–24 months, and those who were formula-fed for the entire 24 months. There were no differences in the prevalence of sickness (sick days per year), but the number of episodes of diarrhea and otitis media were significantly less in the breast-fed group compared to the formula-fed group during the first 12 months.[11]

Research in Scotland confirmed that breastfeeding was associated with substantially lower rates of gastrointestinal illness, and that the benefits lasted up to one year even though breastfeeding was exclusive only for the first 13 weeks.[14] Scottish scientists also found that even the introduction of supplements, defined as formula feeds, cow's milk or solid feeds, did not undermine the protective effects of breast milk, suggesting that it was some positive substance in breast milk rather than the avoidance of potentially infected feeds that reduced the incidence of gastrointestinal illness.[14] However, the mothers in the Scottish and American studies[11,14] were unlikely to be malnourished, milk composition was most probably nutritionally adequate for their infants, and infants were only included in the studies if they were full term. This contrasts with the situation in The Gambia and in many other developing countries, where

Calcium (mg)	Iron (mg)	Zinc (mg)	Phytate / iron (molar ratio)	Phytate / zinc (molar ratio)
6	1.1	0.7	15.7	27.4
11	0.8	0.7	19.1	26.3
13	0.9	0.4	17.7	22.8
30	0.8	0.3	24.4	24.4
49	0.9	0.5	9.7	22.0
6	1.0	0.6	7.6	13.8
20	0.8	0.6	10.1	15.1
49	0.8	1.2	4.7	3.5
39	1.1	0.6	4.8	10.4
106	1.6	0.8	0.3	0.7
11	0.4	0.1	1.1	3.7

Countries of origin included Malawi,[a] India,[b] Philippines,[c] Thailand[d] and Papua New Guinea[e]

TABLE 3: Minimum dietary energy density required to attain the level of energy needed from complementary foods in 1–5 meals per day, according to age group and level of breast milk energy intake (BME).[#,##]

Energy	6–8 Months			9–11 Months			12–23 Months		
	Low BME	Average BME	High BME	Low BME	Average BME	High BME	Low BME	Average BME	High BME
Total energy required + 2SD (kcal/day)	769	769	769	858	858	858	1118	1118	1118
BME (kcal/day)	217	356	160	701	479	257	90	346	602
Energy required from complementary foods (kcal/day)	552	356	160	701	479	257	1029	772	516
Minimum energy density (kcal/g)									
One meal/day	2.22	1.43	0.64	2.46	1.68	0.90	2.98	2.24	1.50
Two meals/day	1.11	0.71	0.32	1.23	0.84	0.45	1.49	1.12	0.75
Three meals/day	0.74	0.48	0.21	0.82	0.56	0.30	0.99	0.75	0.50
Four meals/day	0.56	0.36	0.16	0.61	0.42	0.23	0.74	0.56	0.37
Five meals/day	0.44	0.29	0.13	0.49	0.34	0.18	0.60	0.45	0.30

[#]Assumed functional gastric capacity (30 g/kg reference body weight) is 249 g/meal at 6–8 months, 285 g/meal at 9–11 months and 345 g/meal at 12–23 months.
[##]Total energy requirements are based on US longitudinal data averages plus 25% (2SD) for boys and girls combined (with permission).[22]

TABLE 4: Minimum daily number of meals required to attain the level of energy needed from complementary foods with mean energy densities 0.6, 0.8 and 1.0 kcal/g for children with a low level of breast milk intake, according to age group.[#,##]

Energy density kcal/g	Number of meals		
	6–8 Months	9–11 Months	12–23 Months
0.6	3.7	4.1	5.0
0.8	2.8	3.1	3.7
1.0	2.2	3.5	3.0

[#]Assumed functional gastric capacity (30 g/kg reference body weight) is 249 g/meal at 6–8 months, 285 g/meal at 9–11 months and 345 g/meal at 12–23 months.
[##]Total energy requirements are based on US longitudinal data averages plus 25% (2SD) for boys and girls combined (with permission).[22]

maternal nutrition is poor, breast milk may be nutritionally inadequate and infant weight may be low at birth.[4] In these circumstances, even though the number of days of sickness per year may appear to be only slightly higher in developing[10] compared with developed countries,[11] the nutritional needs of the convalescing child may not be met in developing regions.

The consequence of dietary inadequacy is growth faltering, especially in those children born with weights and lengths below WHO standards.[8] Furthermore, the more malnourished a child becomes, the greater his/her risk of disease. A study in Mexico found that moderately malnourished children under two years of age (<75% of standard weight for age) had a two-fold greater risk of diarrhea (eight episodes per year) compared with the incidence in normally nourished children (weight for age >90% of standard; 3.3 episodes per year).[15] However, in spite of all the evidence from growth faltering in developing countries that breastfeeding fails to provide adequate nutrition, there is convincing evidence that breast milk provides protection against gastrointestinal infection and diarrheal disease.[16] In early infancy, many components of the immune system are still developing and the supply of breast milk to augment these deficits is critical.[9] Diarrhea is a problem in both developing and developed countries,[11,14,15,17] and a continuing supply of breast milk through infancy is critical in order to reduce morbidity and mortality from diarrheal disease, especially in environments where disease and infection are rife. Thus, the global recommendation is for exclusive breastfeeding for the first six months of life and continued breastfeeding until two years of age.

Complementary foods

By about six months of age, the energy and nutrients provided by breast milk are no longer adequate to meet an infant's needs. In the developing world, locally prepared complementary foods are given to infants as their appetite, in the opinion of their caregiver, increases. Cereals or starchy roots and tubers usually form the basis of such foods and they are usually prepared as thin gruels, hence their energy and nutrient-density are low. Furthermore, the phytic acid, dietary fiber and polyphenol content of many plant-based complementary foods is often high, and whether consumed alone or with breast milk, they can inhibit absorption of essential micronutrients such as iron and zinc.[18] Unfortunately, in developing countries, complementary foods are often given before six months, and so displace breast milk and exacerbate mineral deficiencies induced by low body stores at birth because of prematurity, low birth weights and poor maternal nutritional status during pregnancy.[18,19]

Gibson et al[18] calculated the energy and nutrients available in locally prepared complementary foods for infants of various ages in India and several developing countries in Africa and SE Asia, and investigated whether such foods actually met estimated needs. Data was obtained from recipes collected by the authors and their colleagues, as well as from literature. The energy, nutrients, and anti-nutrients as well as the phytate:zinc and phytate:iron molar ratios were calculated from the authors' own analyses as well as literature values where necessary, and are shown in **Table 2**.

Locally prepared complementary foods fall into three groups – those prepared from maize or wheat, those prepared from rice and those based on starchy roots or tubers. The dry components for cereal-based foods comprise mainly cereal (20–30%) and legumes (7–10%), but usually the main component in these foods is water (70–90%). Foods prepared from bananas, yams, potatoes or sago are of a thicker consistency and can contain much less water.

Table 2 shows energy, iron and zinc densities and the phytate:mineral ratios in locally prepared complementary foods. Adequacy of intake will depend on the supply of breast milk and the volume of complementary food consumed. The latter will be controlled by appetite, frequency of breastfeeding, caregivers' feeding habits and size of the child, sickness, etc. Gibson et al examined the adequacy of the feeds for a 9–11-month-old infant who they estimated might consume 750 mL, i.e., three meals of 250 mL each per day. Assuming this volume is consumed, all the complementary foods shown in **Table 2** meet the desired energy, protein, thiamin and copper densities required except for the sago gruel at the bottom of the table, which is very low in protein, thiamin and riboflavin.

However, over half the foods failed to meet the required nutrient density for riboflavin, and when moderate bioavailability was assumed, nearly all foods failed to meet required nutrient densities for calcium and iron. Half of the foods met the desired zinc density if moderate bioavailability was assumed, but none if low bioavailability was assumed. In fact, the bioavailability of iron and zinc from cereal-based porridges is likely to be low as most cereals contain a high content of phytic acid. The latter forms insoluble complexes with iron, zinc and calcium, inhibiting absorption. Reduction of phytic acid by using refined flours, polished rice or other technologies will enhance zinc bioavailability[20] and simultaneously increase absorption of iron and calcium to some degree.[18] However, refining flour and polishing rice also removes other essential micronutrients, especially thiamin and riboflavin. Increasing mineral content by the addition of legumes is also not an ideal option, as legumes too contain high amounts of phytic acid.[18]

Infants and young children between 6–24 months of age consume breast milk in decreasing quantities over time. To meet their nutritional requirements, intake of complementary foods including solids needs to increase. Dewey and Brown[21] calculated the relative contributions of energy, protein and other nutrients from breast milk and complementary food for infants in developing countries based on data on energy expenditure, growth and body composition from longitudinal studies on US children consuming breast milk and complementary foods.[22] The data for energy densities is shown in **Table 3**. They calculated the energy densities needed in complementary food where infants received one to five servings per day. Obviously, the highest energy densities are needed where infants receive only one serving of complementary food per day, and the lowest where they might receive five. Whether or not they receive the recommended energy intake depends on the amount of breast milk consumed. Those consuming the lowest amounts of breast milk will need the largest amount of complementary food and vice versa.

> "Children aged 6–23 months who are not breastfeeding are 3.7 times more likely to die than those who continue to be breastfed"

What is interesting to note is that most of the minimum energy densities shown in **Table 3** fall within the range of energy densities for the home-prepared complementary foods shown in **Table 2**. In a way, this is not surprising, for home-prepared complementary foods have supported the growth of millions of children in the world for hundreds of years.

The problem that should not be overlooked, however, is of course that an unacceptably high number of infants do not

TABLE 5: Acceptable and recommended nutrient intakes for infants from 6–24 months.

Nutrient	Adequate intake 6–12 months	RDA 1–3 years
Ascorbic acid (vitamin C), mg/day	50	15
Thiamin, mg/day	0.3	0.5
Riboflavin, mg/day	0.4	0.5
Niacin, mg/day	4	6
Vitamin B_6, mg/day	0.3	0.5
Folate, µg/day	80	150
Vitamin B_{12}, µg/day	0.5	0.9
Pantothenic acid, mg/day	1.8	2.0 (AI)
Biotin, µg/day	6	8 (AI)
Retinol, µg RAE ##	500	300
Vitamin K, µg/day	2.5	30 (AI)
Vitamin D, µg/day	5	5 (AI)
Vitamin E, mg/day	5	5
Calcium, mg/day	260	700
Iron, mg/day	11 (RDA)	7
Zinc, mg/day	3 (RDA)	3
Copper, µg/day	220	260

Data abstracted from reports by the Institute of Medicine.[5,34–36]

Adequate intakes (AI) obtained from nutrient concentrations in breast milk. Recommended Dietary Allowance (RDA) is the daily dietary intake of a nutrient considered sufficient to meet the requirements of 97.5% of healthy individuals in each life-stage and gender group. It is calculated based on the estimated average requirement (EAR), and is usually approximately 20% higher than the EAR.

##Retinol activity equivalents.

survive. Children aged 6–23 months who are not breastfeeding are 3.7 times more likely to die than those who continue to be breastfed.[1] There are many reasons why breastfeeding may be discontinued or reduced, especially if a child is left with a caregiver during the day. Such children are more likely to fall into the low breast milk energy (BME) category. If, in addition, a caregiver fails to provide feeds at sufficiently frequent intervals, the child is deprived of food – or if complementary feeding is excessive, this can displace the need for breast milk. Home-produced feeds can become contaminated during hot weather; children become sick and eating is reduced, and on recovery, children may not receive sufficient energy and nutrients to make good the losses suffered during illness, etc.

> "The role of complementary food is to supplement the infant diet and not displace breast milk"

So, although complementary feeds with low energy densities can and do rear children through infancy to childhood, there is a high risk of undernutrition associated with them which can lead to permanent stunting, with its long-term consequences on adult height, school performance and future wages.[23] The balance between the intake of breast milk and complementary food has to be right – the role of complementary food is to supplement the infant diet and not displace breast milk.

Feeding guidelines for the general population

To simplify the information in Table 3, Dewey and Brown[21] outlined practical information on the use of complementary foods in developing countries to provide the minimum desirable energy density and meal frequency needed to meet requirements. They assumed that infants would only obtain low energy intakes from breast milk as these estimates provided the most conservative assumptions. Table 4 shows the minimum number of meals required by infants of different ages if energy density varied from 0.8 to 1.0 kcal/g. Thus for all but one of the foods shown in Table 2 – where energy densities were at least 1 kcal/g – to meet recommended energy intakes, three servings a day would be required by infants under 12 months and four servings by infants 12–23 months. If the energy density of the complementary food was less than 1.0 kcal/day, then proportionally, more

meals would be required to make up the shortfall in energy caused by a low breast milk intake (Table 4). So, for the rice-based complementary recipe used in the Philippines (Table 2), infants under 12 months would need four meals a day, and young children between 12–24 months, five meals.

Similar objectives form the basis of the Integrated Management of Neonatal and Childhood Illnesses (IMNCI) guidelines in West Bengal, India, and a community-based, cross-sectional study of infant feeding practices was conducted during 2007–8 in the Bankura district to determine how well their guidelines were being followed. Appropriate complementary feeding for a breastfed child was defined by the IMNCI as three katori (150 g) of solid, semi-solid or soft food in 24 hours at 6–11 months of age, and five portions from 12–23 months. In total, 647 children aged less than two years were selected using a two-stage, 40-cluster sampling method from 18,136 people living in 3,318 households.[24] The study found that breastfeeding was universal, 57% were exclusively breastfed for six months (recall information), continued breastfeeding rates at 12–15 and 20–23 months were 98% and 89% respectively, and complementary feeding was introduced to 55% of infants between 6–8 months (recall information).

Unfortunately, appropriate feeding as defined by IMNCI guidelines fell gradually from 75% to 39% over the first six months and then steeply to around 15% after the first six months. The main reason for the departure from the guidelines was the increasing use of water and other types of milk for infants between birth and eight months. Complementary foods were introduced relatively late, feeding frequency was low and amounts given were inadequate. In addition, 86% of mothers failed to initiate breastfeeding within the first hour, 5% had not started at 24 hours and the overall prevalence of pre-lacteal feeding was 27%.[24] These inadequacies in the early infant diet no doubt significantly contribute to the high prevalence of multiple micronutrient deficiencies in pre-school children in West Bengal[25] and other parts of India.[26]

Micronutrients in home-prepared complementary foods

Energy content is not the only consideration when assessing the nutritional adequacy of complementary foods. Gibson and colleagues have pointed out that many traditional recipes have drawbacks in terms of low or absent concentrations of minerals and other micronutrients, together with high phytate concentrations, which reduce the bioavailability of iron, zinc and calcium.[18] Adequate and recommended nutrient intakes for infants from 6–24 months are shown in Table 5, and calculations on the riboflavin content of home-produced complementary foods in Table 6.

Even though the amount of food consumed increases as infants and young children grow, an adequate amount of riboflavin was present in only one of the recipes described by Gibson et al.[18] The poor micronutrient quality of complementary foods is of course a good reason to maintain breastfeeding for as long as possible. Unfortunately, where mothers are malnourished, their milk too, may not provide adequate micronutrients.[4]

Poor micronutrient quality in the food of young infants and their primary female caregivers is illustrated in a recent study of dietary intakes of young children and women in rural Bangladesh.[27] Twenty-four hour dietary intakes were measured on two non-consecutive days in a representative sample of 480 children and women in two sub-districts in northern Bangladesh using 12-hour weighed food records and subsequent 12-hour recall in their homes. Table 7 summarizes the probabilities of micronutrient adequacy based on the measurements of intake and dietary diversity scores. The overall mean prevalence of adequacy of micronutrients for children was 43%, and for women, 26%. Of the micronutrients illustrated in Table 7, only vitamin B_6 and zinc in breastfed children were >50% adequate. The authors found that the mean probability of adequacy (MPA) was correlated with energy intake and dietary diversity, and multivariate models including these variables explained 71–76% of the variance in MPA. That is, the probability of dietary adequacy in both women and young children is mainly explained by monotonous diets low in energy.

Dewey and Brown describe some of the methods attempted in order to improve the nutritional value of locally prepared complementary foods.[21] These include lowering phytate content to improve the bioavailability of iron, zinc and calcium,[18] and altering viscosity and other sensory properties of the diet.[28–30] For example, a study in rural South Africa examined the effects of energy density on intake in 30 children aged 6–23 months.[28] The study compared local maize-milk porridge (energy density of 0.6–1.1 kcal / g) with a similar porridge with added α-amylase (to reduce viscosity) and additional cereal. The additional cereal increased energy density to 1–1.3 kcal / g, while the amylase helped to match the viscosity of the two feeds. Overall, children ingested 6% less of the porridge with greater energy density, but consumed approximately 24% more energy – and importantly, micronutrients – when fed the meal with the enhanced composition.

Another study was designed to compare intakes of two local food mixtures with energy densities of ~1.1 in one and ~0.6 kcal / g in the other, each at high and low viscosities. This research was carried out on 18 fully weaned Peruvian children 8–17 months of age, who were hospitalized and recovering from malnutrition or infection.[29] A reduction in viscosity was achieved by adding α-amylase, and other sensory properties of the food were held constant by adding specific additives. The children ate substantially more of the less energy-dense food but they obtained significantly more total energy from the high-energy-

TABLE 6: Inadequacy of riboflavin concentrations for infant nutrition in locally prepared complementary foods.[#]

Complementary Food		Riboflavin	Riboflavin intake from 3 meals at:		
			6–8 Months	9–8 Months	12–23 Months
Composition	Ratio by weight (origin)	mg/100 mL	249 g/Meal	285 g/Meal	345 g/Meal
Unrefined maize flour: cow peas: ground nuts: water	17:10:5:68 (Malawi)	0.05	0.37	**0.43**[##]	**0.5175**
Unrefined maize flour: soya flour: sorghum: ground nuts: water	20:3:1:4:72 (Malawi)	0.04	0.30	0.34	0.414
Refined maize flour: soya flour: water	22:6:72 (Malawi)	0.02	0.15	0.17	0.207
Wheat: sorghum: brown sugar: oil: water	15:2:12:3:68 (Malawi)	0.01	0.07	0.09	0.1035
Rice: kidney beans: roasted sesame: sugar: water	4:1:7:1:87 (Philippines)	0.02	0.15	0.17	0.207
Rice: mung beans: ghee: water	30:7:4:59 (India)	0.03	0.22	0.26	0.3105
Rice: sorghum: brown sugar: oil: water	18:3:12:4:63 (India)	0.02	0.15	0.17	0.207
Rice: dried fish: ground nuts: water	20:3:6:71 (Thailand)	0.03	0.22	0.26	0.3105
Banana flour: ground nuts: sugar: water	13:18:24:45 (Philippines)	0.06	**0.45**	**0.51**	**0.621**
Sweet potato: egg: dried skim milk: oil: sugar: water	47:28:6:3:3:13 (Papua New Guinea)	0.20	**1.49**	**1.71**	**2.07**
Sago flour: wheat: brown sugar: oil: water	16:1:10:4:69 (Papua New Guinea)	0.00	0.00	0.00	0.00

[#]The calculations assumed functional gastric capacity (30 g/kg reference body weight) and meal sizes of 249 g at 6–8 months, 285 g at 9–11 months and 345 g between 12–23 months.

[##]Numbers highlighted indicate that foods eaten contained adequate dietary riboflavin.

density, low-viscosity food. Other experiments in West African infants aged 6–10 months, in which gruels were modified with α-amylase to alter viscosity and incorporated varied proportions of millet and sucrose, found the highest intakes were of the unmodified gruels but that energy intakes from preparations with the greater energy density increased by 40%.[30]

The common factor among these three experiments was that the highest intakes were of the foods with the lowest energy density – presumably an attempt by the infants' bodies to meet their energy needs. Nevertheless, the energy obtained by the infants was proportional to the energy density of the foods, so although quantitatively the amount of high-energy-density food consumed may be lower than that of the low-energy-density food, energy and micronutrient intakes were greater from the high-energy-density food. However, none of these studies were done in children who were still breastfeeding, so it is not known whether total daily energy (and micronutrient) intake would have altered if the children had still been breastfeeding.[21]

Strategies to improve complementary feeding practices

It is internationally recognized that after six months, infants cannot be sustained by breast milk alone and require additional nutrition. WHO has identified a number of guiding principles for optimal complementary feeding.[3] Breastfeeding should continue frequently and on demand until two years of age or longer. Complementary feeding should start at six months with small amounts of food. As the child gets older, the frequency and variety of complementary foods should increase. Food variety is important to ensure that all nutrient needs are met. Fortified complementary foods or vitamin-mineral supplements should be used as needed. During and after illness, fluid intake should be increased and the child should be encouraged to eat more

TABLE 7: Probability of micronutrient deficiencies in the first 1000 days in women and young children in northern Bangladesh[#]

Nutrient	Prevalence of adequacy % mean ± SD[##] (median)	
	Breastfed children	Lactating women
Vitamin A	5 ± 16 (0.2)	0 ± 1 (0)
Thiamin	43 ± 42 (24)	16 ± 27 (1)
Pyridoxine	92 ± 24 (100)	87 ± 25 (100)
Cyanocobalamin	29 ± 43 (0)	0.5 ± 6 (0)
Folate	3 ± 14 (0)	0 ± 0 (0)
Iron	17 ± 16 (15)	24 ± 23 (16)
Zinc	59 ± 41 (72)	14 ± 24 (2)
Calcium	0 ± 0 (0)	0 ± 0 (0)

[#]Probability of adequacy was calculated from 24-hour dietary intakes of 11 micronutrients on two non-consecutive days and dietary diversity from the number of food groups consumed.

[##]Standard deviation.

TABLE 8: Energy allowance from complementary food to avoid displacing breast milk and maintain continued breastfeeding.

Age of child (months)	Energy needs from complementary foods for a breastfed child (kcal/day)
6–8.9	200
9–11.9	300
12–23.9	550

From reference[31] with permission.

food and more often. Finally, mothers should be encouraged to practice good hygiene, proper food handling and feed responsively to the child's psychosocial development.[3]

"WHO has identified a number of guiding principles for optimal complementary feeding."

There are a growing number of food products on the market for feeding infants and young children during the period when breastfeeding alone is no longer sufficient to meet nutritional requirements. Public health strategies for improving the nutritional status of children through the provision of fortified foods focus on the following three types of product:[31]

1. **Fortified blended foods:** Any prepared porridge or cereal fortified with micronutrients to help fulfill the nutritional needs of young children after the age of six months, in addition to breast milk. These foods are intended to replace traditional local porridges or paps when they are inadequate to fulfill nutritional needs, or to be given to children in addition to such foods, for example in government feeding programs.

2. **Complementary food supplements:** Fortified food-based products meant to be added to other foods or eaten alone to improve macronutrient and micronutrient intake. Some examples include low-quantity LNS (lipid-based nutritional supplements) such as fortified peanut spread and fortified full-fat soy powder.

3. **Micronutrient powders:** Pre-packaged specific combinations of micronutrients intended to be added at the point of consumption (home fortification) to local porridges, paps or family foods to address gaps in micronutrient supply and improve the nutritional status of children.

In all cases, the basic concern is that the marketing or use of any of these products would increase the risk of an early cessation of exclusive breastfeeding, or the displacement of breastfeed-

ing after six months of age. To minimize the risk of any interference in the initiation or maintenance of breastfeeding, the Maternal Infant and Young Child Nutrition Working Group of the 10 Year Strategy to Reduce Vitamin and Mineral Deficiencies developed a document entitled, "Using the code of marketing of breast milk substitutes to guide the marketing of complementary foods to protect optimal infant and young child feeding practices,"[31] and the WHO has been charged at the World Health Assembly (WHA) in 2012 as part of WHA Resolution 65.6 to provide clarification and guidance on the inappropriate promotion of foods for infants.[32,33]

Quinn et al[31] consider that the code is not explicit on how to avoid undermining continued breastfeeding after six months, and they believe it important that manufacturers of complementary foods do not recommend an intake likely to depress a child's appetite for breast milk. In the "Guiding Principles of Complementary Feeding,"[3] WHO suggests that calories from breastfeeding during the second year of life approximate, on average, 35–40% of a child's diet. On this basis, WHO has defined the energy needs from complementary foods for infants with an average breast milk intake **(Table 8)**. Labels should not suggest a daily ration of the product in excess of the amounts shown in the table.

Conclusions

To reduce the enormous loss of life of children younger than five years old, WHO recommends that infants should be fed breast milk exclusively for the first six months of life and that breastfeeding should continue for at least 18 months or longer thereafter. Diarrhea is a major cause of morbidity in infancy, and breast milk appears to provide some protection against gastrointestinal disease. Complementary foods should not be introduced until a child is six months old, and the amounts should be increased gradually until they are eating typical family foods. Most home-produced complementary foods have low but adequate energy densities to support growth. However, the content of many micronutrients in these foods is low and the content of anti-nutrients like phytate can be high, impairing availability of iron, zinc and calcium. Thicker and more energy-dense complementary foods may be less readily consumed than weaker gruels by infants, but the energy and micronutrient intake of these may be higher than those of gruel. WHO recommends that complementary foods be fed with a spoon or other implement and not a bottle, so as to protect breastfeeding. If commercially prepared foods are used to increase micronutrient intake, their packaging instructions should clearly show that they are for the older infant and should in no way undermine continued breastfeeding. In essence, complementary food should supplement the infant's diet and not in any way displace breast milk.

Sight and Life supports breastfeeding

Sight and Life supports not only the message of exclusive breastfeeding for the first six months of a child's life, followed by the introduction of safe and appropriate complementary feeding together with continued breastfeeding for the first two years of life or beyond, but also the need to ensure optimal nutrition of not only pregnant women, but all women of childbearing age. A total lifecycle approach is necessary in order to fully address malnutrition.

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Opinion: Response to "Adequate Nutrient Intakes for Infancy, Part 2: Complementary Food from 6 to 24 Months"

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Complementary foods that are introduced in a timely manner, and are nutritionally adequate, safe, and appropriately fed – along with continued breastfeeding – are critical to the nutrition, health and development of infants and young children between 6–24 months of age. The World Health Organization (WHO) defines "timely" as at six months of age, "adequate" as meeting the child's nutrient requirements, "safe" as hygienically prepared, stored and fed, and "appropriately fed" as fed responsively or fed in a manner that responds to a child's signals of hunger and satiety.[1] As noted in the article by Thurnham in this issue, complementary foods should not displace breast milk, but rather, should complement the child's diet by providing nutrients that are limited in breast milk after six months of age.

"Complementary foods should not displace breast milk, but rather, should complement the child's diet by providing nutrients that are limited in breast milk after six months of age."

While there is evidence, as stated by Thurnham, that some nutrients in breast milk, particularly thiamin, riboflavin, vitamin B_6, vitamin B_{12}, vitamin A, iodine, and selenium, are affected by maternal status,[2] evidence does not support his assertion that breastfeeding fails to provide adequate nutrition in settings where maternal nutritional status is poor, nor that the poor quality of complementary foods is the main cause of growth faltering. In this commentary, I will focus on two issues that are important in evaluating the relationship between nutrient adequacy and growth failure.

First, to evaluate the key point made in Thurnham's paper about the nutritional adequacy of breast milk and commonly used complementary foods in developing countries to meet young child nutritional requirements, it is first necessary to understand the concept of an Adequate Intake (AI), as defined by the Institute of Medicine (IOM) that sets the US Dietary Recommended Intakes. AIs are used as nutrient requirements when there is insufficient scientific evidence to set an Estimated Average Requirement (EAR) or Recommended Dietary Allowance (RDA). As defined by the IOM, "The AI is a recommended average daily nutrient intake level, based on experimentally derived intake levels or approximations of observed mean nutrient intake by a group (or groups) of apparently healthy people that are assumed to be adequate."[3] While an AI is assumed to meet the nutrient requirement, the extent to which intake of a nutrient may exceed the actual requirement is known. Among children age 1 to 3 years, 64% of nutrient requirements are AIs, extrapolated from studies of older children and adults. With the exception of iron and zinc, for which an EAR is set using the factorial method, AIs for infants age 7 to 12 months are based on both average intake of breast milk and usual intakes of complementary foods of children living in the U.S. Therefore, research that estimates the gap between requirements and intake by young children – either through breast milk or complementary foods – may overestimate the gap because of how the AI is derived, especially because U.S. infants often consume fortified complementary foods. Caution needs to be exercised in positing that estimated gaps necessarily infer deficiency.

Second, growth faltering, particularly stunting, in developing countries is well-documented to be caused by the synergy between poor nutrient intakes and infection.[4–6] Recently, the role of tropical enteropathy (characterized by villous atrophy, crypt hyperplasia, increased permeability, and inflammatory cell infiltrate and caused by fecal bacteria ingestion), has received renewed attention.[7] Tropical enteropathy does not necessarily lead to diarrhea but rather is a subclinical infection that results in malabsorption, leading to growth faltering. Not surprisingly, tropical enteropathy is more prevalent where maternal nutrition is poor and the complementary feeding is inadequate. Therefore, growth failure among breastfed infants cannot be assumed to be due to the quality of breast milk. Also, while fortified comple-

mentary food supplements, such as lipid-based nutrient spreads, have been helpful in improving linear growth, the magnitude of the effects usually only mitigate a part of the growth deficits observed, indicating the large effect of non-nutritional factors in the etiology of growth failure.

As established by Gibson et al., breast milk continues to provide a large proportion of infant and young child micronutrient requirements, as well as immunological protection, through to the age of two years.[8] Towards the end of the first year, it provides about one-third to two-thirds of average total energy and essential fatty acids, which are often lacking in complementary feeding diets. For a child between 9–11 months of age – who consumes an average amount of breast milk, and where the mother is well-nourished – breast milk provides the entire requirement for vitamins A and C, 50% of the requirement for thiamin and riboflavin, 40% of the requirement for vitamin B_6 and calcium, and 20% of the requirement for zinc. Virtually all of a child's requirement for iron needs to come from complementary foods, which is why iron deficiency and anemia are so prevalent among young children.

While Gibson and colleagues demonstrate that traditional complementary feeding diets are deficient in key micronutrients, many can be improved through fermentation, germentation, and the addition of locally available animal-source foods. Supplements such as micronutrient powders (MNP), fortified complementary foods and/or lipid-based nutrient supplements (LNS) can also help fill certain gaps. However, in the absence of a strategy for social and behavior change communication, neither improved local complementary foods nor complementary feeding supplements are likely to be effective in improving child nutrition because feeding and hygiene practices have not changed. Micronutrients sensitive to maternal nutrition can also be increased in breast milk by improving maternal diets. Communities where babies are born and develop also need access to water and sanitation systems, and their families need access to a diverse diet.

In closing, evidence does not support Thurnham's assertion that growth faltering is due to the fact that breastfeeding fails to provide adequate nutrition during infancy and early childhood. As amply demonstrated in the literature, growth faltering is the result of the interaction between inadequate diet and infection (including subclinical tropical enteropathy), and is underpinned by poverty. I wholeheartedly agree with Dr Thurnham that research on maternal nutrition in relation to breast milk composition, as well as research on the composition of complementary foods and child nutritional status, is sorely needed. At the same time, operational research is equally important to provide programmatic action on how local foods can be used to improve complementary feeding diets and how families can be helped to feed and care for their young children to support healthy growth and development.

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Development of an Interactive Web-Based Tool to Depict US Nutrient Adequacies

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Key messages

- Micronutrient deficiencies continue to contribute to the global burden of disease worldwide.
- While low nutrient intake is more prevalent in low-income countries, developed countries are also affected by nutrient deficiencies in sub-populations.
- The National Health and Nutrition Examination Survey (NHANES), conducted continuously in the United States of America (USA) since 1999, provides nationally representative nutrient intake data that can be used to identify sub-populations at risk of nutritional deficiency.
- The Micronutrient Calculator website was created to improve access to NHANES data for public health nutritionists, the food industry and others interested in the nutritional status of the USA's population.
- Low intakes of fiber, choline, vitamin E, vitamin K, calcium, magnesium, potassium, and the carotenoids were found in the general population.
- Differences in the pattern of nutrient intakes were found according to gender, age, ethnicity and household income sub-populations.
- The website can be visited at **www.micronutrientcalculator.org**

Introduction

Adequate intakes of vitamins and minerals are essential for maintaining human health. The contribution of micronutrients such as iron, vitamin A and iodine to the prevention of morbidity and mortality in large sectors of the global population, particularly low and middle-income countries, is well documented.[1] The Global Burden of Disease Study 2010 estimates that 340,000 child and maternal deaths were caused by deficiencies in vitamin A, zinc and iron that year. These accounted for almost 3% of the global disease burden, representing a large decrease since 1990 but still unacceptably high for preventable conditions.[2] Food insecurity and nutrient deficiencies in high-income countries also exist. For example, in 2008 14.6% of households in the United States were considered food insecure and 5.7% had very low food security, with higher rates found in households with children.[3] Nutrient inadequacies may be found in specific sub-populations; reports show that factors such as ethnicity, household income, education, age and gender affect intakes and biochemical markers of nutritional adequacy.[4–7]

Food insecurity in high-income countries is related to the distribution of wealth throughout all sectors of society. Disposible household income determines not just the amount but also the types of foods consumed. This ultimately changes the pattern of foods consumed and nutrient intakes. In ethnically diverse countries such as the USA, cultural background can also have a strong influence on food preferences and intakes.[8] Disparities in health outcomes amongst common US ethnic groups are found for many diseases that are related to nutrition. For example, the burden of obesity and its related morbidities are higher in people of African American descent than in other groups that make up the rest of the general population.[9] Looking at intakes of particular nutrients, Hispanic women are at a higher risk of having a pregnancy affected by a neural tube defect, relating to lower intakes of folic acid through culturally appropriate staple foods.[10] Knowledge of the nutrients that bring concern can help shape interventions targeted at risk groups.

The US Centers for Disease Control and Prevention (CDC) has been conducting a continuous survey of the US population's health and nutritional status through the nationally representative NHANES since 1999.[11] Using a complex, multi-stage probability design, a representative sample of non-institutionalized civilians is selected. In every two-year cycle, 7,500 to 8,500 individuals are examined. Participants take part in a detailed battery of health and nutrition-based examinations. To determine nutrient intakes, two 24-h dietary recalls are performed on non-consecutive days and compared to a database of the nutrient content of foods. The data, once stripped of all information that may identify the participants, are made available for public health purposes on a rolling basis. The CDC provides summary data online, however it is static and can be difficult to locate and interpret for public health nutritionists. As a practicum project for the Masters of Public Health in Nutrition at the University of Massachusetts, Amherst, the data was analyzed, summarized and presented via an interactive website.

Practicum objectives

1. Provide NHANES data summarizing nutrient intakes, grouped by age, gender, household income and ethnicity, in a format that can be easily accessed and used by Public Health Nutritionists.
2. Use a visual element to enhance data interpretation and identification of risk nutrients.
3. Place intakes in context by linking them to nutritional recommendations.

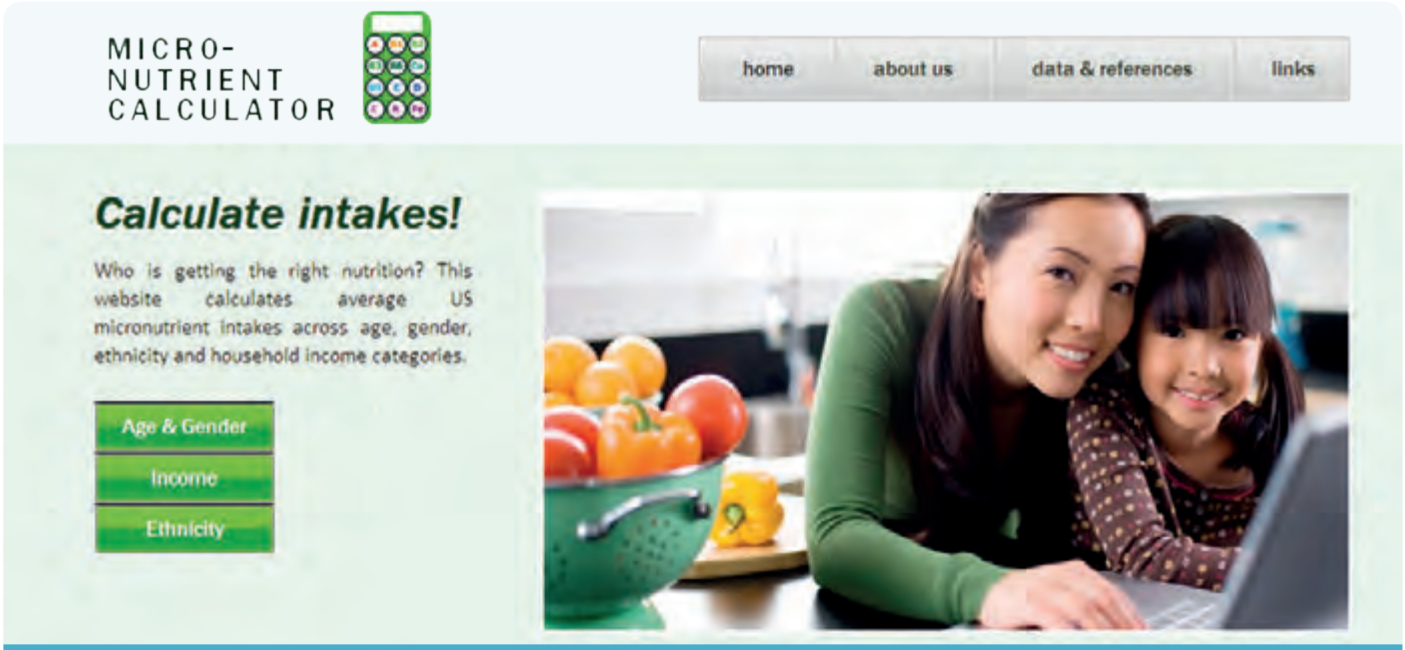
Data preparation

Dietary and demographic datasets were downloaded from NHANES cycles 2003–2004, 2005–2006, and 2007–2008. Dietary data was taken from both 24-h dietary recalls and the National Cancer Institute (NCI) method was used to estimate usual intake and percentiles of intake from foods.[12] A balanced replication approach was used in conjunction with the NCI method to develop standard errors and confidence intervals. In the model, co-variants included day of the week (weekday / weekend) and interview type (in person/telephone). The dataset was stratified for gender and grouped by age. Further sub-groups based on income categories (up to $24,999, $25,000–$74,999, and above $75,000), and ethnicity (White, African American and Mexican American) were calculated. Where possible, Estimated Average Requirements (EARs) from the US Dietary Reference Intakes (DRI)[13] were used to compute the percentile of each age, gender, ethnicity and household income group not meeting the recommendation. EARs are set at levels that meet the nutrient needs of 50% of the population. Exceptions to this were made for the nutrients fiber, choline, vitamin K, calcium, and potassium, for which only an Adequate Intake (AI) has been set; iron, for which only data for the RDA was available; and the carotenoids α-carotene, β-carotene, lutein and zeaxanthin, lycopene and total carotenoids, for which no recommended intake exists, therefore levels based on carotenoid intake achieved through recommended fruit and vegetable consumption were used.[14]

All analyses were performed using SUDAAN software (version 10.0; Research Triangle Park, NC), and the data was exported into Excel worksheets, re-coded and imported into Microsoft Access 2003. To further improve the utility of the data for public health nutritionists, recommendations for each age and gender group were added to the data. A prototype that included interactive and visual elements was created using Microsoft Access 2003. The interactive elements consisted of pages to allow selection by age / gender, age / ethnicity and age / household income, with drop-down menus to offer the user a choice of subgroups within these categories. Conditional formatting based on a percentage of the population not meeting the recommendation was used to offer a visual means to assess nutrient adequacy.

Technical aspects of website design

The main website was created using html and css from a template.[15] After basic testing, these were converted to aspx for server implementation. The Microsoft Access database was converted to Microsoft SQL Server 2008 in order to upload it to the server. The conditional formatting on the percentage of the population not meeting the recommendation was presented in a "traffic light display" similar to the one used by Troesch et al.[16] to effectively provide visual cues indicating nutrient adequacy. General nutrition information about each nutrient on the web-



The Micronutrient Calculator offers public health nutritionists a convenient tool to quickly assess nutrient intake needs of a broad range of age, gender, ethnicity and household income categories.

site was created and added behind a pop-up window in the table. Other content was created to complement the data and provide further information on nutrient intakes, sources and other similar web-based nutrition tools. The website is available at: **www.micronutrientcalculator.org.**

How do nutrient intakes vary by age group, ethnicity and household income in the USA across the population?

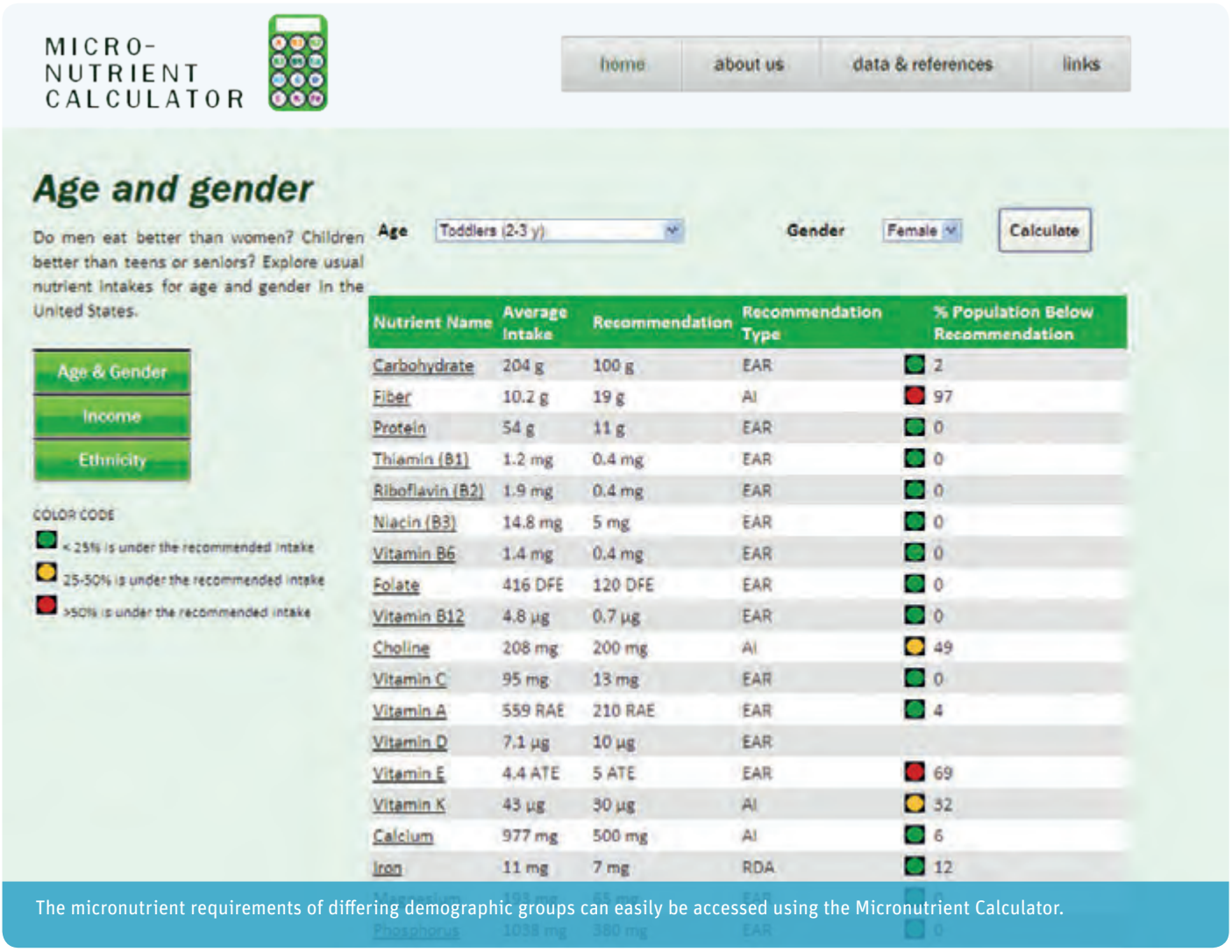
The amount of data presented on the website is considerable and an in-depth analysis is beyond the scope of this article. Nevertheless, there are some clear trends in the data that can be further investigated.

For all age groups and genders, nutrient intakes are almost universally adequate for a number of vitamins, minerals and macronutrients. These nutrients are carbohydrate and protein, the B-vitamins, phosphorus, selenium and zinc. For other nutrients, less than half the population met the EAR or AI, indicating a marked risk of inadequacy across the population. These nutrients included fiber, choline, vitamin E, vitamin K, calcium, magnesium, potassium, and the carotenoids. Low intakes of many of these nutrients are related to poor adherence to fruit and vegetable intake recommendations; only around 7% of US adults meet age and sex-specific food-based dietary guidelines for fruits and vegetables.[14] Choline intakes are low because there are few foods rich in choline, and the few good sources are not consumed in large enough quantities on a population level.[17] Calcium intakes in adults decline with age, as total energy intakes decline, therefore the lower intakes are seen in older age groups. Vitamin E is found predominantly in foods with a moderate to high lipid content, such as oils, nuts, seeds, grains and fatty meats. When oil or fat is heated for frying, much of the vitamin E is destroyed, therefore fatty foods that are commonly consumed in the US such as fried potatoes contain low levels of vitamin E. Magnesium is commonly found in whole grain products, nuts and legumes; food items that are in line with US dietary guidelines yet are not consumed at adequate levels.[18,19]

The mean intake of vitamins A, C and D provided evidence that at least half the population met requirements. However, overall intakes were low and a significant number of people in the population may actually be at risk of inadequacy and deficiency. This is backed up by biochemical data showing that 0.3%, 6% and 17.2% of the general population is deficient in vitamins A, C and D, respectively.[20] Large differences in the DRI for iron between women aged 14 and 50 and the other population groups mean that even though overall intakes are adequate, iron deficiency is more common in women of childbearing age.

Men tend to have higher nutrient intakes than women due to higher overall food consumption. For some nutrients, the DRI is higher and does not impact the percentage of the population meeting requirements. Nutrient intakes in toddlers and young children are generally better than older populations, while for adolescents aged 14–18, high nutritional requirements mean that they are most at risk of inadequate intakes.

The income categories chosen reflect low, average and high economic status when compared to the median US household income of around $50,000, and the 130% threshold of the Federal Poverty Level Guidelines, which was $24,505 for a family of four in 2004.[21,22] Overall nutrient intakes are higher in the



The micronutrient requirements of differing demographic groups can easily be accessed using the Micronutrient Calculator.

highest income category, a phenomenon that has been found in other examinations of nutrient intake by income level in the US.[8] Nutrient-rich diets tend to be associated with a higher cost; a diet high in the nutrients dietary fiber, vitamins A, C, D, E, and B_{12}, β-carotene, folate, iron, calcium, potassium, and magnesium was associated with increased dietary cost.[23] Higher intakes of fruits, vegetables, whole grains and dairy in higher income groups accounted for higher intakes of vitamin C, β-carotene, potassium and magnesium in a recent analysis of the NHANES dataset.[8]

Looking at ethnicity, there were some differences in intakes found. African Americans generally had the greatest risk of inadequacy, Whites had the lowest risk of inadequacy, and Mexican Americans had nutrient intakes that mostly lay in between. Some exceptions to these trends were seen for folate, choline, calcium, and magnesium, where the highest intakes were seen in the Mexican American subjects; vitamin C, where the Whites clearly had lower intakes than the other ethnic groups; and for vitamin K, the African Americans had the lowest risk of inadequacy. In the USA, ethnicity affects not only cultural practices surrounding general eating patterns, but is also somewhat confounded with socioeconomic status, and this may reflect social, political disadvantages or neglect. Ethnic differences in cultural cohesion may also influence the effectiveness of general nutrition education interventions,[24] reflected by a lower percentage of minority populations meeting nutritional guidelines.[8] Differences in food consumption patterns due to variants in the cultural or socio-political environment underlie the disparities found in micronutrient intake by ethnicity.

The interactive website developed based on NHANES data offers public health nutritionists and other interested parties a convenient tool to quickly assess nutrient intake needs of a broad range of age, gender, ethnicity and household income categories.

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profile

The Bigger Picture

A Day in the Life of Howard Schiffer

Howard Schiffer is President and Founder of Vitamin Angels, the not-for-profit organization which reduces child mortality worldwide by connecting essential nutrients with infants and children under five.

***Sight and Life* (S&L):** *Howard, what is the mission of Vitamin Angels?*

Howard Schiffer (HS): Vitamin Angels' mission is to mobilize and deploy private sector resources to advance availability, access and use of micronutrients, especially vitamin A, among at-risk populations in need.

S&L: *What inspired you to found Vitamin Angels?*

HS: I founded Vitamin Angels in 1994 in response to the Northridge Earthquake in Southern California. At the time, I ran a natural products company, and when a disaster relief agency contacted me requesting a donation of vitamins for the children of the migrant workers who had been displaced by the earthquake and were at an increased risk of illness as a result, I helped out. A few weeks after the disaster, I learned about vitamin A deficiency and how simple and cost-effective this intervention is. One high dose vitamin A every six months could save a child's eyesight and life and it only costs around 25 US cents per year. I couldn't believe it. I continued to educate myself about undernutrition and vitamin supplementation, and Vitamin Angels was born. It was the perfect way to do something meaningful with my life. Vitamin Angels married my background in childbirth education and midwifery with my corporate background in developing and selling products in the natural products industry.

Today, Vitamin Angels helps at-risk populations in need – specifically children under five, pregnant women, and new mothers – to gain access to lifesaving and life-changing micronutrients. Our focus is reducing childhood morbidity and mortality through vitamin interventions. We distribute vitamin A to children under five, a solution proven to reduce mortality rates in at-risk populations by about 24 per cent. We also reach children, women and new mothers with daily multivitamins to support proper mental and physical development.

> "One high dose vitamin A every six months could save a child's eyesight and life and it only costs around 25 cents per year"

S&L: *Where does the name of the organization come from?*

HS: Vitamin Angels always seemed like the obvious descriptor for what we were doing: rallying people with the greatest resources to reach children with the greatest need and the fewest resources.

S&L: *What distinguishes Vitamin Angels from other players in the nutrition space?*

HS: The biggest difference between Vitamin Angels and other players is our focus: we target the children no one else is reaching. These children are often the most difficult to reach and also the most vulnerable. We partner with organizations already working at the village level, where vitamins can make a huge difference in the children and women's lives they are reaching.

S&L: *Why is the distribution of vitamin A so important in the developing world?*

HS: According to the United Nations World Health Organization (WHO), vitamin A deficiency affects an estimated 190 million children worldwide. The body doesn't produce vitamin A on its own: it has to be taken in via the diet. For economic or geo-

"I always say I have the best job in the world"

"Vitamin Angels helps at-risk populations gain access to lifesaving and life-changing micronutrients"

graphic reasons, however, most of our beneficiaries lack access to foods containing sufficient vitamin A.

Vitamin A is a micronutrient essential for proper immune function and maintenance of structural integrity of cells. Cellular structure and a functioning immune system are vital body defenses for reducing the effects of infectious diseases causing death or disease. Vitamin A deficiency is a major contributing cause of childhood blindness, death and sickness among children under five from such common diseases as measles, malaria, acute respiratory tract infections and diarrhea.

S&L: *Could you tell us something about Vitamin Angels' Operation 20/20 program?*

HS: Our flagship program, Operation 20/20, was created in 2005. The program focuses on reaching children under five years of age who are most vulnerable to the effects of vitamin A deficiency (VAD). For children under five, a simple, cost-effective dose of vitamin A every six months can reduce child mortality rates by 24 per cent and the risk of early signs of blindness caused by vitamin A deficiency by 68 per cent. This is an incredibly simple and cost-effective solution to a major global health problem. And the global community agrees: in 2008, the Copenhagen Consensus – a group of the world's leading economists – named vitamin supplementation (specifically vitamin A and zinc) as the number one solution to the world's greatest problems. They also noted that supplementation brings with it a 1:17 cost to benefit ratio. Again in 2012, the Copenhagen Consensus noted that "bundled micronutrient interventions to fight hunger and improve education" were their first choice for impacting global problems. In 2012, through Operation 20/20, we reached approximately 26.5 million children under five with high dose vitamin A in 42 countries.

> "In 2012, through Operation 20/20, we reached approximately 26.5 million children under five with high dose vitamin A in 42 countries"

S&L: *Could you tell us something about Vitamin Angels' Thrive to Five campaign?*

HS: Thrive to Five has been formally operating since 2009. The program focuses on reaching children under age five along with pregnant women and new mothers with daily multivitamins. Many of the children we reach are suffering from 'hidden hunger' – a lack of essential micronutrients that can lead to disease or even death. This type of undernutrition can lead to irreversible physical and cognitive damage. Additionally, well-nourished children take greater advantage of available educational opportunities and tend to grow up to lead more productive lives. In 2012, Vitamin Angels reached approximately 360,000 children and mothers in 33 countries including the US.

S&L: *What is the relationship between Vitamin Angels and Sight and Life?*

HS: Vitamin Angels first began working with *Sight and Life* in 2004. Last year, *Sight and Life* transferred the responsibility both for the management of direct distribution of vitamin A and for their initiatives intended to catalyze locally sustainable vitamin A supply and distribution systems to Vitamin Angels. We are now partnering with DSM, which funds *Sight and Life*, to create a self-funding, India-centric distribution model. This program will be a model for sustainability with all of the vitamin production, funding sources, and distribution partners, being Indian companies, individuals and organizations.

"India is home to 37 per cent of the world's vitamin A deficient children"

S&L: *What is Vitamin Angels aiming to achieve specifically in India at present?*

HS: India is home to 37 per cent of the world's vitamin A deficient children. And, according to Government of India statistics provided to WHO, 62 per cent of all preschool-age children are vitamin A deficient (VAD). This has caused WHO to classify VAD as a severe public health problem in India. The Government of India launched a massive vitamin A supplementation (VAS) program in the 1970s to reach all children 9–59 months. However, despite the existence of the VAS program for more than three decades, VAD still persists in many districts and states of India. Government healthcare programs and those carried out by international organizations in conjunction with the Government of India report reaching 43 per cent of the country's children who are eligible for vitamin A supplementation through national healthcare systems. The Indian Government would need to invest significantly in infrastructure, human and material resources to be able to cover the remaining 57 per cent of eligible children.

Vitamin Angels currently works with more than 100 non-governmental organizations (NGOs) in India that deliver vitamin A to more than 2,500,000 children under five years of age. Organizations collaborating with Vitamin Angels include such varied organizations as eye hospitals and their outreach programs, general hospitals, and a range of community-based organizations.

S&L: *What are your hopes of the SUN (Scaling Up Nutrition) movement?*

HS: Our hope would be to see the SUN movement grow significantly. Some of the countries that are not participating are glaring omissions. We would also hope that the SUN movement and the partner countries would also support the work which is being done by indigenous NGOs, non-profits, faith-based groups, missionaries and local doctors, clinics and hospitals. There are countries which are part of SUN who are still blocking the entry of lifesaving nutrients into their countries.

S&L: *You have received a remarkable number of awards in recognition of your work – the Dietary Supplement Education Alliance's DSEA Hero Award; a Lifetime Achievement Award from Nutrition Business Journal; Golden Temple and Peace Cereal's Socially Responsible Business Award; the NNFA West Outstanding Achievement Award; the Santa Barbara Independent newspaper Local Hero Award; the Global Humanitarian Award from Vivekanand International; and the Socially Responsible Business Award from Nutrition Business Journal for Vitamin Angels' work around the world. What do these awards mean to you?*

HS: We are always appreciative of any awards or recognition we receive, primarily because it helps us give a voice to the children we are reaching. We are humbled by awards but recognize they are only one small part in the effort to reach these children: without our donors' support or without the help of our in-country partners, Vitamin Angels would only be a good idea.

S&L: *You are the author of three books: How to Be a Family: The Operating Manual, How to Be the Best Lover: A Guide for Teenage Boys and First Love: Remembrances. What is the relationship between these titles and your work with Vitamin Angels today, and are you working on any new writing projects?*

HS: My books are a response to give young people honest information so they can make better choices. All of the books sprang from a desire to give young people the information I wish I had when I was starting out in relationships and with my family. When my son was 13, I realized that everything the culture says about women is awful. 'Best Lover' and 'First Love' are an attempt to course correct, to let him see that intimacy is all about connection and relationship. My work with Vitamin Angels is also about setting things straight – on the most fundamental level, we believe that every child, every pregnant woman, and every mom who has just given birth has a right to essential nutrients. And I am currently working on a new major writing project that is still under wraps!

S&L: *Family life is obviously very important to you. Could you tell us something about your family today?*

HS: My family is what makes my work possible. My wife, Kim, runs a cooking school in Spain, has a catering business, and is a gourmet chef. I always say that we work on opposite sides of the nutrition equation. My children are all incredible: Austin is a musician and has two Northwest Bluegrass groups up in Portland, Oregon; Zoe is a talented writer, majoring in political science at Berkeley; and Eliana finished her junior and senior year in high school last year so she can work in developing countries, she is presently at a midwifery clinic in Bali.

S&L: *What do you love most about your work?*

HS: I always say I have the best job in the world because I get to work with everyone at a heart level. I've spoken at so many meetings when these tough guys who are managers of the stores we partner with come up to me after my talk in tears; they're so moved by the work we're doing. And I meet mothers and children who have nothing, who still invite me into their homes to share whatever they have and tell me they are so thankful we showed up in their village. These connections mean everything to me.

S&L: *What are you like to work with?*

HS: I am not a manager, so you have to be very self-motivated and driven to work with me. I am also very much in the moment, always thinking of new ideas and pushing for us to be able to do more. Fortunately, we have wonderful people and some talented managers at Vitamin Angels who help put in the structure and focus that you need to run a large organization.

S&L: *Is there a thinker or leader who has significantly inspired you in your work?*

HS: I have always loved the Goethe quote: "Until one is committed, there is hesitancy, the chance to draw back … whatever you can do, or dream you can do, begin it. Boldness has genius, power, and magic in it. Begin it now." There is no reason why Vitamin Angels should even exist. We never had a celebrity or an angel investor or received any funding from the government. We just had a commitment to make a difference in these children's and mother's lives.

S&L: *Very few people in the world ever manage to found a successful organization and keep it going over the course of many years. Could you share with us the secret of your success?*

HS: So much of it is luck; being in the right place at the right time and working doggedly and passionately for 19 years! At the risk of sounding too 'California', it always felt like we had angels guiding us. I honestly do believe that this is the work Vitamin Angels was put here to do. We've also had such talented people join our team, they have played a key part in Vitamin Angels' growth.

S&L: *You sign off your emails: "Upwards!" What keeps you going in the face of difficulties?*

HS: I meditate daily and do yoga and get out for a walk in nature – this helps keep me centered. I have a strong spiritual life and a family that totally believes in this work. I have an incredibly dedicated team that makes Vitamin Angels rock every single day. And I always remember the children we are reaching.

S&L: *If you could change one thing in the world to make the work of Vitamin Angels easier, what would it be?*

HS: I would love it if people realized that lack of vitamins and vitamin A is one of the biggest global health challenges facing the world today. Most people can identify AIDS or malaria as health crises, but have no idea about chronic malnutrition, undernutrition or vitamin A deficiency. And this is a problem that we already have the solution for.

S&L: *How can people get involved with the work of Vitamin Angels and offer it their support?*

HS: Companies can get involved by developing cause-marketing partnerships with us to raise funds while increasing their sales and building internal morale. Others can support us through donations of raw materials or services or money, "liking" us on Facebook (facebook.com/vitaminangels), signing up for our e-newsletter, and so on.

S&L: *Is there anything else you'd like to tell our readers, Howard?*

HS: Most children who are born in the developing world today will never reach their full intellectual or structural capacity because of the chronic malnutrition of their mothers before they were even conceived. Vitamin Angels believes that every child has a right to receive essential nutrients and basic nutrition. We believe that every mother has a right to get prenatal vitamins during her pregnancy to ensure a healthy pregnancy and delivery. What occurs during the first 1,000 days of life (from conception to the age of two) can set the course for an entire lifetime. Vitamin Angels is fully committed to reaching children, women and mothers during these early days and giving them a chance to lead full and productive lives.

Howard Schiffer *was interviewed by Jonathan Steffen*

"We target the children no one else is reaching"

Biography: Howard B Schiffer, President and Founder of Vitamin Angels

"After a successful career in the natural foods industry Howard founded Vitamin Angels in 1994. Under Howard's leadership, Vitamin Angels has twice been named a Top 10 "Highly Rated Charity Relying Solely on Private Contributions" by Charity Navigator in addition to earning five consecutive 4-star ratings from America's Premier Charity Evaluator.

In 2003, Howard was honored with the Dietary Supplement Education Alliance's, DSEA Hero Award for his work in "making a difference in the lives of so many children throughout our country and around the world."

He was awarded the Key to the City of Lowell Massachusetts by Major, Bud Caulfield, and in 2010, Howard accepted a Certificate of Special Congressional Recognition from the office of Congresswoman Niki Tsongas of the Fifth Congressional District of Massachusetts on behalf of Vitamin Angels.

Sight and Life Interview

Venkatesh Mannar Receives the Order of Canada

Venkatesh Mannar is the President of Micronutrient Initiative (MI). For nearly 40 years he has worked to reduce debilitating deficiencies amongst those most at risk of malnutrition around the world. In December 2012 he was appointed as an Officer of the Order of Canada for his major contributions to the fight against worldwide malnutrition.

***Sight and Life* (S&L):** *You were recently made an Officer of the Order of Canada. What does this honor mean to you?*

Venkatesh Mannar (VM): I feel very honored and at the same time it is great that the award will raise awareness of the scale of undernutrition worldwide. It's also a great validation that highlights how the Canadian government continues to be committed to reducing the global burden of malnutrition. Over the last twenty years, Canada has spent over Can $1 billion in supporting the international nutrition effort.

> "The Canadian government continues to be committed to reducing the global burden of malnutrition"

S&L: *Can you tell us something about the Order of Canada itself? What role does it play in Canadian public life?*

VM: To be made an Officer of the Order of Canada is a highly regarded distinction. The order was set up by HM Queen Elizabeth II in 1967 to reward the outstanding service on the part of Canadian people who have made a major positive difference to the country. It is one of the country's highest civilian honors and recognizes people from all sections of Canadian society.

S&L: *You are Indian by birth and have achieved considerable distinction in Canada – a country that was once a foreign land to you. What does India mean to you today, and what does Canada mean?*

VM: I have lived and worked in Canada for 22 years. It is my adopted home. Of course, I am still proud of my Indian roots and still maintain strong family connections. My work takes me back there often. I like to be considered as both Canadian and Indian. It may sound strange, but in fact since moving to Canada I have been able to help India's undernutrition situation more than I would have had I stayed there. Through MI and Canadian support we've been saving and improving the lives of millions of people through our health programs and interventions. This may not have been possible to initiate through Indian health agencies because of the magnitude of the problem and limited resources and capacity.

I'd also say that receiving the award speaks greatly of the country's attitudes and values. It is a society built on the merits of its citizens and it's known for encouraging immigrants such as myself to succeed, which is very rare indeed. It makes me very proud to be a Canadian citizen as well as an Indian.

I hold a Canadian passport, but as India doesn't allow its people to have dual nationality, I hold an Overseas Citizen of India card (OCI), which is not a passport; instead it essentially acts as a multiple entry visa, so I can visit India for as long as I want to.

S&L: *Your origins, and those of your family, are in the salt harvesting business in India. In what ways have these early experiences influenced your later career in micronutrient nutrition?*

VM: My family had been in the salt harvesting business for five generations. In order to take over from my father one day, I needed the necessary technical training, so I went to study in the USA. On returning to India, UNICEF was completing studies concerning the use of iron and iodine in salt to reduce mental impairment and goiter. In the early 1980s I got involved with studies by UNICEF and later on with other UN agencies such as WHO. Gradually, I was being drawn away from salt production, and in the late 1980s I became a consultant with UNICEF in order to instigate salt iodization programs in other countries across Latin America, Africa and Asia. I later became interested in fortifying other foods such as flour and cooking oils.

"I am upbeat about recommending nutrition as a career for young people"

Venkatesh as a young man: "I am still proud of my Indian roots and still maintain strong family connections"

"My background knowledge in salt harvesting informed my unlikely career path"

The Micronutrient Initiative (MI) was formed in the early 1990s, and I was appointed director in 1994. We were inspired in the initial phases to find out exactly what micronutrient deficiencies are, what they mean in both human and economic terms – and ultimately to raise awareness at scale. My background knowledge in salt harvesting and the improvement of nutrition security informed my unlikely and inspired career path from engineer to nutrition advocate.

S&L: *The British International Development Secretary, Justine Greening, recently announced that all assistance from the UK to India would end by 2015. In your view, is the cutting of such external subsidies a negative or a positive step for India?*

VM: What will be missed will be the expertise of an agency like DFID and its ability to catalyze interventions into action. There will be still be a relationship between Britain and India, but the shift is from direct aid to technical assistance and skill sharing.

S&L: *It is becoming increasingly clear that malnutrition is not limited exclusively to the developing world and that hidden hunger is a growing problem for the industrialized countries of the West. How do you view this development?*

VM: In some developed countries it hasn't been mandatory for some time to iodize salt. In most cases the consumer actually has a choice of which type of salt to buy. However, marginal deficiencies are creeping in at childbirth stage. In most developed countries, an increase has been seen in people with deficiencies. Although this is a concern, it has not yet developed on a major scale. It's been brought about because of a lack of nutrition security – there is food available, but the access to key nutrients is limited due to factors such as a lack of availability or low income.

S&L: *You are the President of the MI, and in this capacity were interviewed in issue 2/2008 of Sight and Life magazine. What have been the key developments with the MI in the intervening five years, and what are your key areas of focus at the moment?*

VM: The Micronutrient Initiative's focus on micronutrients has not altered. Having said that, we recognize that we don't work in a vacuum and our results and processes need to apply to a wide range of nutrition interventions. We have maintained a clear intent to initiate child and maternal health programs. We have also learned how health systems work in countries, how to deliver micronutrients and how to use them in order to remain sustainable. We were fortunate to receive additional funding in 2010 from the Government of Canada through the Muskoka Initiative on Maternal, Newborn and Child Health. These new funds are allowing us not only to expand the reach of our activity but, more significantly, to leverage micronutrient initiatives as entry points to improve the quality of antenatal care for mothers, revitalize weak diarrhea treatment programs, and help transform ad-hoc, donor-dependent campaigns to reduce child mortality into sustainable, nationally driven approaches. We have also received additional funding for innovative projects on the scale-up of the use of zinc for diarrhea treatment from donors such as Teck and the Children's Investment Fund Foundation.

Our core programs are still strong. In 2008, MI commemorated the procurement of the five billionth vitamin A capsule for supplementation programs around the world and the millions of lives saved from capsule distribution programs. When a health worker gives a high-dose supplement to a child, it protects that child for four to six months, but it also means we need to continue ensuring that we get the capsules to those in need. We are now nearing the 8 billion capsule mark, and as governments continue to work towards improving the nutritional status of

"Through MI and Canadian support we've been saving and improving the lives of millions of people"

their children, we hope to continue supporting partners and governments with this life-saving program for those children most at risk.

The MI has also employed scientific and technical experts to introduce rigor in terms of presenting evidence of impact and effectiveness of interventions. The skill sets needed to ensure this must eventually be transferred to specialists in developing countries so that effective nutrition actions at the community as well as individual level are sustained.

"We should all support and draw from SUN"

S&L: *The Scaling Up Nutrition (SUN) Roadmap was published in 2010. What has the movement achieved since then, in your view, and what are your hopes for it going forward?*

VM: I have worked closely with SUN since its inception and I remain very involved. SUN is a very good initiative: it came into being as a response to claims that health and nutrition agencies across the world were disorganized and in disarray. With this in mind, SUN was designed as a call to action and to unify all sectors. There still is a need to collaborate to find what issues are critical, what needs to be done today. I think it's great that it has happened, and we should all support and draw from SUN as well for our own individual programming.

S&L: *You have published widely and been a member of many influential bodies in the nutrition space. What aspects of your career to date give you the greatest satisfaction, and why?*

VM: I get satisfaction from having been a part of some major nutrition interventions that have had great impacts at a global level. I am happy to note that I've seen the number of countries using iodized salt globally increase significantly, similarly with vitamin A. There's been great progress and MI has played a role in that. I'm also satisfied that these positive changes are 'at scale' and that the impact on child survival rates and maternal health is steadily improving.

Equally important is the need to give developing countries ownership and their own responsibility and commitment to deal with these issues by themselves. This is because interventions and agencies come and go but governments are around forever. No single country has gotten to this stage yet, but it won't be too long before some can be in this position.

S&L: *Is there anything you would do differently if you could start you career again?*

VM: There was no grand design to my career path. After training

to be an engineer and returning to India, I could have stayed there. I had no idea that my interests would grow so big and that large aspects of my career would come about almost by chance. It wasn't until the move to Canada that all the pieces fell into place.

However, if I tried to follow the same career path today, I probably couldn't. There's no organic career progression between being an engineer and becoming a nutrition advocate.

S&L: *You have been made an Officer of the Order of Canada for your leadership in the global fight against malnutrition de-ficiency. If people see a leader in you, who are the leaders you admire, and why?*

VM: I admire Bill Gates. He is a businessman who has devoted his life path to helping humanity. He's a huge role model and fully deserving of the Nobel Prize, which no doubt he'll be awarded one day.

Also, being of Indian descent with a background in the salt harvesting industry, I would have to mention Gandhi. His whole leadership and vision for the nation and his non-violent movement is an inspiration. In particular, I admire his tenacity and the way he tackled the Raj over their punitive tax rates on Indian harvested salt with the Dandi March in 1930, which my own family was part of. From those origins to becoming one of the world's most respected leaders, he will always remain an inspiration for me.

"I am upbeat about recommending nutrition as a career"

S&L: *What would you advise a young person eager to embark on a career in nutrition today?*

VM: I am upbeat about recommending nutrition as a career for young people. There is a valid need for high-quality programmers and researchers, because the work calls for drive and innovation to design effective interventions. It's a real challenge to establish where to go to or who to ask for definitive answers. It's true to say that firm conclusions are elusive, because many interventions are context-specific and contradictory, so the model cannot be applied to other 'similar' programs. Shifting paradigms and advances in the sciences are constantly re-shaping our goals, and this renders conclusive research problematic. Future generations of nutritionists need to know how to make good decisions and which studies to reference. It's an ever-changing field, yet I openly welcome the next generation of nutritionists, particularly in the developing world.

S&L: *Any other comments?*

VM: I would like to highlight the important role that companies in the private sector such as DSM play in the fight against hunger and undernutrition. *Sight and Life* exists because of the vision and foresight of companies like this. I think *Sight and Life* is a very good example of supporting, documenting and dissemination of the best available knowledge and scientific information. I sincerely hope that the publication continues to grow and grow.

Venkatesh Mannar *was interviewed by Jonathan Steffen*

Gandhi and the Salt *Satyagraha*

Gandhi led a direct action campaign of tax resistance against the Raj in 1930. Known as the Dandi March (or the Salt Satyagraha) it was a non-violent protest against the salt monopoly in India. Tax for salt harvested in India was held at a punitive rate by comparison to the rate on British imported salt. The 24 day, 240 mile march's aim was to produce salt without paying tax. Gandhi was joined by a growing number of Indians and the march sparked massive unrest across the nation. Over 80,000 Indians were arrested as a result of the protests and the campaign had a massive effect on the push towards Indian independence.

Source: *www.wikipedia.org, January 2013 (abridged).*

Sharing knowledge for improved nutrition.

Sight and Life is a humanitarian nutrition think tank of DSM

DSM

Remembering John Martin Scott

A Man Dedicated to Combating Spina Bifida through Research

Anne Molloy
Associate Professor in the Department of Clinical Medicine and Director of the Vitamin Research Laboratory, Trinity College Dublin, Ireland

Irish scientist John Martin Scott, who was Professor of Experimental Nutrition at Trinity College Dublin (TCD), has died aged 72. His career at TCD included advancement to Fellow of TCD (1973), Bursar (1977–80), Personal Chair (1978), Doctor of Science (1981), Member of the Royal Irish Academy (1984) and Senior Fellow, TCD (2005).

Though he became an internationally recognized expert on folic acid and its role in metabolism, John entered this field purely by chance. After a PhD at TCD, he began a post-doctoral fellowship with Jesse Rabinowitz in Berkeley, California. However, when shown his assigned project, he asked to work on something different. The subsequent switch to folate metabolism set the course of his career.

Returning home, he joined TCD's new Biochemistry department. At a time when little biomedical research was being done in Ireland, John collaborated with TCD Regius Professor of Medicine Donald Weir to carry out 'bench-to-bedside' research, eventually publishing over 100 articles and reviews on folate and vitamin B_{12} metabolism.

Breaking new ground

The focus of John's later career was the role of nutrition in preventing neural tube defects (NTDs) such as spina bifida and anencephaly, which were prevalent in Ireland at the time. After attending a lecture by Dr Dick Smithells of Leeds – whose studies suggested a link between NTDs and vitamin deficiency in pregnant mothers – John suggested further work, leading to a joint publication in 1980. He then started a program to identify the relationship between folate metabolism and NTDs.

After his team had collected a wide range of maternal blood samples from Ireland, John published a seminal paper in the Journal of the American Medical Association in 1995. The paper demonstrated that the risk of NTDs was strongly related to the mother's red blood cell folate level and remained high until folate levels were well above the deficiency range. Cited in more than 500 journals, this paper's conclusions are still used by US public health specialists and elsewhere in food fortification policies. John's work on the prevention of NTDs was funded by the US National Institute of Child Health and Human Development, and became the longest-running contract in their epidemiological research program.

A multi-faceted individual

In recognition of his work, John was awarded Honorary Degrees from the University of Ulster at Coleraine and the University of San Pablo CEU, Madrid. He won international prizes such as the American Society for Nutritional Science's Lederle Award (1997); the Gowland Hopkins Medal (1997); the David Hawkins Lecture, Canada, (1997); and the International Award for Modern Nutrition, Switzerland (1999). He served as expert advisor for the Irish Food Safety Authority and for numerous UK, EU and US scientific committees. He was also on the board of St James Hospital for over 20 years.

An inspirational teacher and mentor, John was voted the first winner of the Provost's Award for Outstanding Contribution to Teaching and Learning, TCD (2001). He loved Dublin and TCD – many eminent scientists attended legendary parties at John's Dublin home, and he delighted in giving guests tours of the city and TCD. A great storyteller, John possessed a wealth of local historical knowledge.

John's beloved wife Bella passed away in October 2010. He is survived by his son Martin, daughter Rachel and sister Una along with his daughter-in-law Heather, son-in-law Ronan and his beloved grandchildren James, Matthew, Charlotte, Isabelle Scarlet and Ava Grace.

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> “The focus of John’s later career was the role of nutrition in preventing neural tube defects (NTDs) such as spina bifida and anencephaly, which were prevalent in Ireland at the time.”

John Scott: An inspirational teacher and mentor who will be sorely missed

Recalling a Legacy

In the Wake of Nevin S Scrimshaw's Passing

Noel W Solomons
Scientific Director, Center for Studies of Sensory Impairment, Aging and Metabolism, Guatemala

I knew and worked with Nevin S Scrimshaw for 48 years, during which time I learned a great deal from his life. Our relationship began when he served as advisor for my undergraduate thesis, cross-registered to the Massachusetts Institute of Technology, where he directed the Department of Nutrition and Food Science. Nevin migrated to Cambridge after serving for 12 years as the Founding Director of the Institute of Nutrition of Central America and Panama (INCAP). The decision that changed my life and career came nine years later, when I chose to conclude my specialty training in gastroenterology and clinical nutrition with a year in Guatemala at INCAP, or "The House That Nevin Built." That one year extended to 37 years and counting.

In 1977, Nevin invited me to join his department as part of its fledgling International Nutrition Program, beginning a long-term commute between Guatemala and Massachusetts. In 1982, when Nevin stepped down after 20 years as Department Head at MIT, I dedicated myself to Guatemala. To project his international interests, Nevin founded the International Nutrition Foundation (INF), and when the Center for Studies of Sensory Impairment, Aging and Metabolism (CeSSIAM) was established in 1985, the INF became indispensable as a safe, accountable channel for its research funding.

In 1997, I was awarded the International Nutrition Prize of the International Union of Nutritional Science, sponsored by the INF, at the Assembly of the 16th International Congress on Nutrition in Montreal. Later, as Irwin Rosenberg and I sat in a café in Montreal, we realized that Nevin was to turn 80 the next year, prompting us to plan a Festschrift celebration for him. This was held on the MIT campus later in his 81st year and published as a journal supplement.

When I first left INCAP in 1986, Nevin tried to mediate and reconcile the CeSSIAM and INCAP movements. Failing that, he became one of its greatest benefactors and supporters, and – I would like to hope – admirers. Perhaps the greatest honor Prof. Scrimshaw ever bestowed on me was attending CeSSIAM's 20th anniversary celebration. He had much to do with CeSSIAM's success – at INCAP, he had established a culture for biomedical research in Guatemala, and his personal drive to explore problems in depth had guided CeSSIAM. Our finances were kept secure by donated funds in the Foundation accounts.

Nevin's prolific travel regimen tapered as he advanced in age. He and his wife Mary were last together in Guatemala in August 2009, where we shared breakfast, and I recall Mary's excitement over a photograph of four generations of Scrimshaw women. Nevin made two long journeys in 2010. The first was in September to attend the II World Congress of Public Health Nutrition in Porto, Portugal, where Nevin participated in a posthumous tribute to his contemporary, Jose Maria Bengoa. The second – his last visit to his beloved Latin America – was in November, when he attended the Latin America Nutrition Leadership Workshop and the 14th Latin American Congress on Nutrition in Chile. At the time, he was intent on editing articles for a compendium history of the early years of INCAP, later published in the Food and Nutrition Bulletin in March, 2011.

> "Perhaps the greatest honor Prof. Scrimshaw ever bestowed on me was attending CeSSIAM's 20th anniversary celebration"

With his passing, the world of nutrition has lost a leader but retained a legacy. Current research at CeSSIAM on non-transferrin-bound-iron as a factor in malaria is grounded in Scrimshaw's Interactions of Nutrition and Infection paradigm, and our exploration of lysine-fortification of maize flour parallels his recent renewal of the amino acid balance agenda. In this world of diverse applied nutrition research, there is virtually no area one can venture into that is not part of the vast Scrimshaw scientific legacy.

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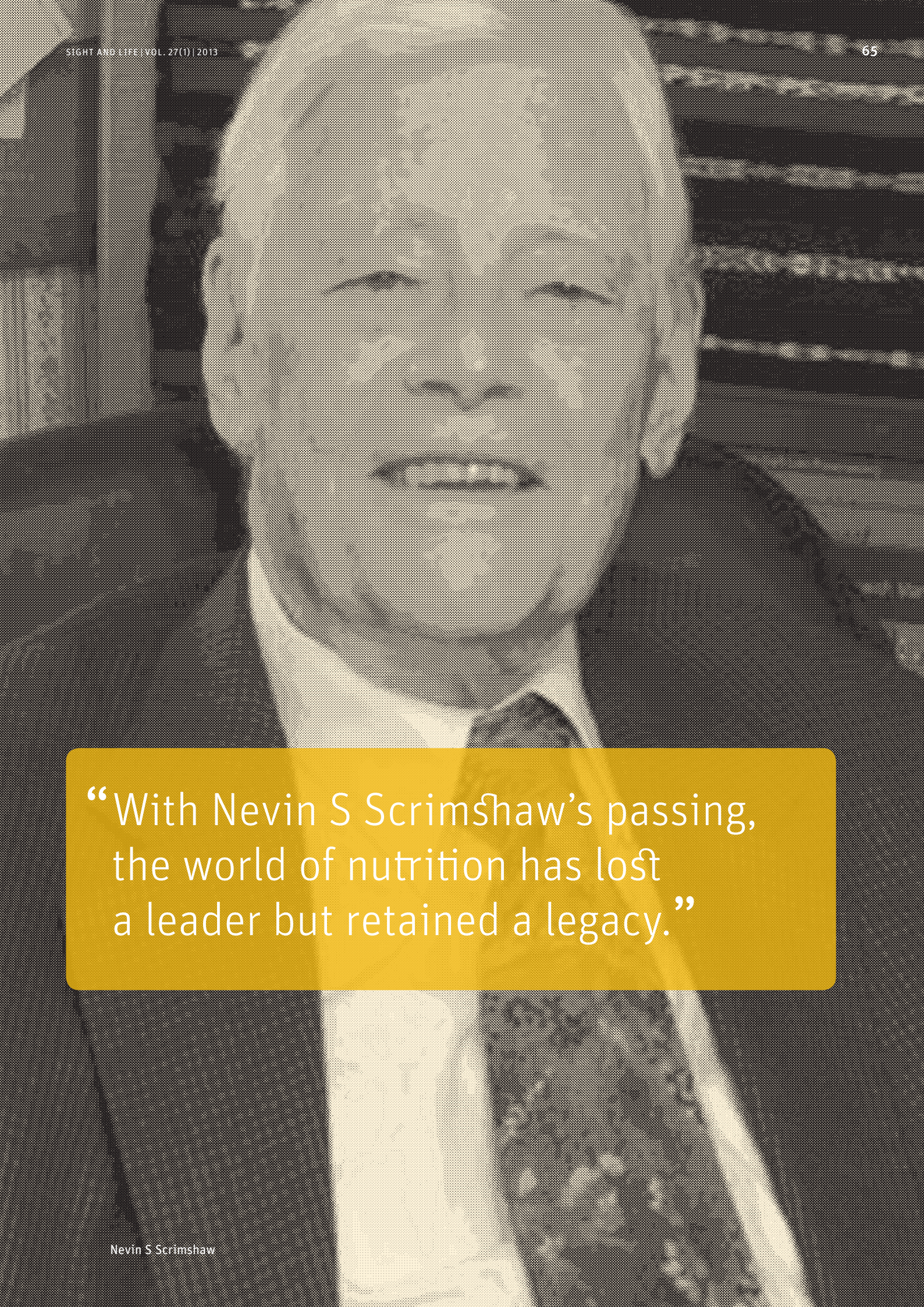


"With Nevin S Scrimshaw's passing, the world of nutrition has lost a leader but retained a legacy."

Nevin S Scrimshaw

9th General Assembly of the International Agency for the Prevention of Blindness

Hyderabad, India, September 2012

Kalpana Beesabathuni
Head of *Sight and Life* India,
Gurgaon, India

Dr Shilpa Vinod Bhatte
Consultant, Vitamin Angels,
Mumbai, Maharashtra, India

Last year, the 9th General Assembly of the International Agency for the Prevention of Blindness (IAPB) was held in Hyderabad, India between September 17 and 20. The theme for the conference was "Eye Health: Everyone's Business." 1,600 participants from the fields of ophthalmology and optometry attended from 66 countries and there was significant participation from those on the frontlines of delivering eye care services in hospitals and community and vision centers. All sectors were represented including government, business, not-for-profit and civil society. One hundred and twenty speakers covered every aspect of blindness prevention.

India is home to 37% of all vitamin A deficient children in the world, an important determinant for childhood blindness. In this context, Klaus Kraemer from *Sight and Life* and Clayton Ajello from Vitamin Angels co-chaired a key panel discussion on "The prevention of vitamin A deficiency (VAD) in Indian children through nutritional interventions."

The most recent meta-analysis of 16 published vitamin A supplementation trials confirmed a 24% reduction in risk of all-cause mortality in children aged six months to five years in response to vitamin A. Evidence also suggested that vitamin A produced a large reduction in the incidence and prevalence of night blindness and in the prevalence of xerophthalmia. Cultural, economic, environmental and social factors in India may contribute to poor vitamin A status – WHO-recommended universal vitamin A supplementation (VAS) in India fails to reach 50% or more of children under five years old. This article summarizes the practical approaches to addressing VAD that were discussed by the panel.

> "India is home to 37% of all vitamin A deficient children in the world, an important determinant in blindness"

There were four Indian panelists. Dr N Arlappa from the National Institute of Nutrition presented an epidemiological overview; Dr Dechenla Tsering from Sikkim Manipal Institute of Medical Sciences covered the effectiveness of the government-sponsored universal VAS; Dr Shilpa Vinod Bhatte from Vitamin Angels presented a novel yet practical model for improving the reach of VAS; and Franklin Daniel from Operation Eyesight Universal described a case study on how to improve coverage in hard-to-reach communities.

An epidemiological overview of preventable blindness in India

Seventy-five percent of the world's blind children live in developing countries; 20% of them live in India. VAD affects vision

Panelists from left to right: Dr N Arlappa (National Institute of Nutrition), Dr Shilpa Bhatte (Vitamin Angels), Dr Klaus Kraemer (*Sight and Life*), Franklin Daniel (Operation Eyesight Universal), Dr Dechenla Tsering (Sikkim Manipal Institute of Medical Sciences), and Dr Clayton Ajello (Vitamin Angels)

by inhibiting the production of rhodopsin, the eye pigment responsible for vision in dim light. VAD causes night blindness, conjunctival xerosis, Bitot's spots, corneal sclerosis, corneal ulceration, scarring and keratomalacia. Corneal scarring resulting from measles, vitamin A deficiency or trauma is the most common cause of preventable blindness among children in developing countries. Though the incidence of clinical VAD in India has declined significantly over the past few decades, the country still has more than 35 million affected people and the highest percentage of vitamin A deficient children in the world. VAD persists as a public health challenge particularly in rural areas.

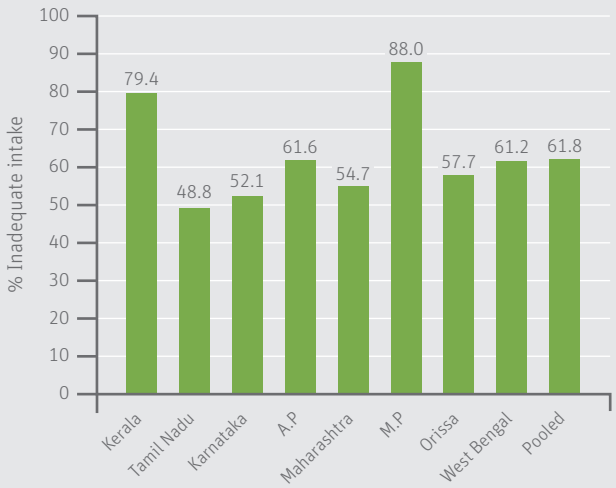
Dr Arlappa described time trends in vitamin A status in India. Time trends in the consumption pattern of vitamin A-rich foods among almost all the rural pre-school children in India showed that they did not meet the recommended dietary allowance (RDA) of 400 µg of vitamin A. The proportion of rural preschool children not meeting even 50% of their RDA of vitamin A was alarmingly high at 81%. In a large-scale state representative study conducted by the National Nutrition Monitoring Bureau (NNMB), the prevalence of clinical and sub-clinical VAD among pre-school children – 0.8% and 61.8% respectively – was higher than the cut-off values recommended by the WHO: 0.5% and 20% respectively. This indicates that VAD is a public health problem in each state surveyed by NNMB **(see Figure 1)**.

The Universal Vitamin A Supplementation program

The vitamin A supplementation program in India is integrated with the Reproductive and Child Health (RCH) program under the Ministry of Health and Family Welfare. The current strategy for VAS among under-five children (6–59 months old) in India is universal coverage with high doses of vitamin A every six months. Dosing was prescribed as 100,000 IU for those less than a year old and 200,000 IU for children under the age of five. Under the RCH program, VAS has been incorporated into the Expanded Program on Immunization and administered through the government healthcare delivery system consisting of primary health centers (PHCs), sub-centers and integrated child development service (ICDS) centers.

Dr Tsering went on to describe the determinants of low coverage of VAS that ranged from 5.9–42.9% across various states, through the Poverty Reduction Strategy Paper Framework. The primary factors were attributed to inadequate and inconven-

FIGURE 1: Prevalence of sub-clinical VAD (<20µg/dL) among 1–5 year old children in states



ient physical accessibility to health centers, low availability of human and material resources, and poor organizational and technical quality leading to doses being omitted. Dr Tsering provided examples of successful coverage in a few states in India and Bangladesh where non-governmental organizations (NGOs) and community mobilizers were involved in extending VAS services. For example, from 2006–2008, local NGOs and international agencies initiated child protection months in the state of Chhattisgarh that helped increase VAS coverage from 41 to 78%.

"State governments do not possess the administrative capacity to provide vitamin A to 57% of eligible children"

The Vitamin Angels model

Vitamin Angels is a not-for-profit organization headquartered in the USA. It is their mission to mobilize and deploy private sector resources to advance the availability, access and use of micronutrients, especially vitamin A, among at-risk populations in need. Dr Shilpa Vinod Bhatte presented the Vitamin Angels model of complementing the Government of India's VAS program to reach those children who are unlikely to receive vitamin A through national healthcare systems **(see Figure 2)**. Only 43% of eligible children are covered under the national program. State governments need more investment in infrastructure and resources to be able to improve coverage directly. Alternatively, they would need greater administrative capacity to provide vitamin A and technical assistance support to NGOs that can reach most of the remaining 57% of eligible children. Moreover, manufacturers do not sell vitamin A to NGOs in small quantities. Vitamin Angels fills this gap by aggregating demand and offering vitamin A supplements to qualified NGOs that are then able to deploy vitamin A through their existing health and community-based programs to children at risk for VAD. Children between 6 and 59 months of age receive two doses of vitamin A in a year. This preventive measure can also reduce child mortality, thus increasing child survival by around 24%. In partnership with *Sight and Life*, Vitamin Angels works with more than 100 indigenous NGOs by building local ownership, responsibility and sustainable distribution systems, successfully reaching more than 2.5 million Indian children.

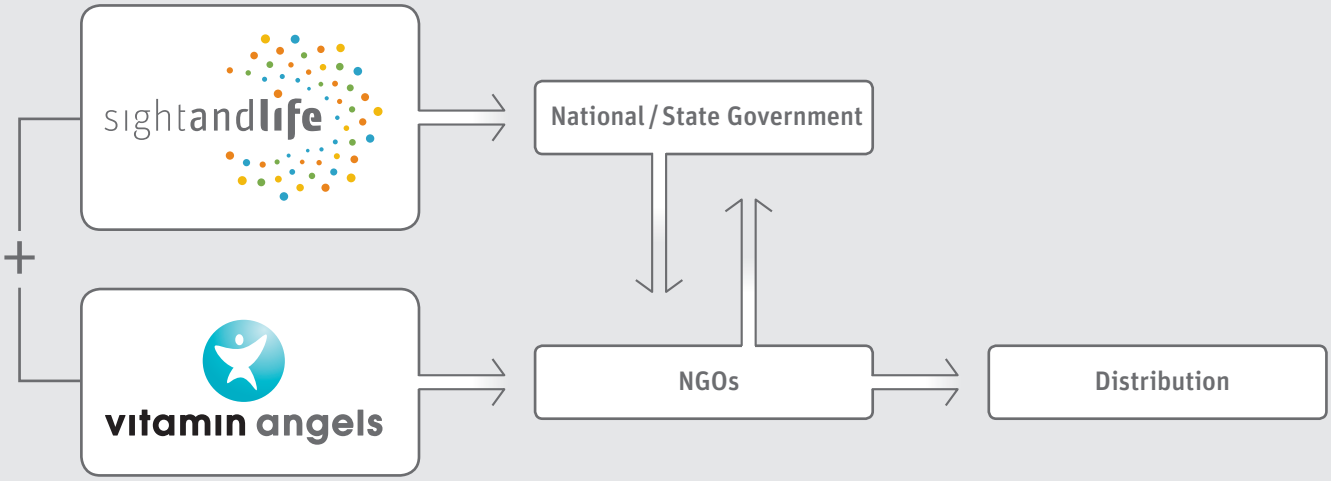
Dr Bhatte urged the eye care community to report VAD, create awareness among various stakeholders and complement the government's efforts through their outreach programs in hard-to-reach communities. She ended her presentation with a thought-provoking quote from the Dalai Lama XIV: "If you think you are too small to make a difference, try sleeping with a mosquito."

Role of community eye health programs

Franklin Daniel from Operation Eyesight Universal (OEU) in India presented the role of community eye health programs in administering vitamin A. OEU is an international development agency founded in 1963. Since its inception, OEU has focused its energy on, and developed expertise in, evolving and implementing innovative approaches to eliminating avoidable blindness. OEU is active in the urban slums of India, implementing a comprehensive eye care program that includes primary eye care. OEU also oversees the programs' integration into the government-run PHC services. OEU's community health staff conducts door-to-door surveys and works closely with government workers, from PHCs and ICDS centers, to track children who have missed VAS. Vitamin A capsules are procured free of cost from Vitamin Angels and administered twice a year to children under five years old.

Moreover, regular health and nutrition education and eye care awareness sessions are held for women and mothers of young children. These information sessions also include best practices for family planning, pre-natal care, sanitation and personal hygiene. These interventions led to improved coordination with local government functionaries as well as a drastic decrease in reported diarrheal and respiratory infections in children. As a result, the community's trust in OEU strengthened, encouraging many parents to seek eye care services for children suffering from cataract and refractive errors. With this urban slum intervention now standardized, OEU expanded its reach through twelve hospital-based community eye health projects. These hospitals are now additional channel partners for the VAS program.

FIGURE 2: Vitamin Angel's approach is through grass-roots coordination



The Exhibit

A booth co-hosted by *Sight and Life* and Vitamin Angels in the exhibition hall provided detailed information on VAD. The exhibit attracted nearly 800 visitors, including many local NGOs, eye hospitals and government representatives, all seeking and sharing information on VAD and vitamin A supply.

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Improving Nutrition in Europe – Renowned Experts Highlight Flour Fortification

European Health Forum Gastein Policy Event 2012

Becky Handforth
Flour Fortification Initiative, Brussels, Belgium

Sarah Zimmerman
Flour Fortification Initiative, Atlanta, Georgia, USA

Key messages

- Populations worldwide are at risk for micronutrient deficiencies even when caloric intake is sufficient.
- Although Europe is considered one of the most developed parts of the world, intake of specific essential nutrients remains suboptimal in the region.
- Flour fortification is a low-cost, widely-recognized method for combating micronutrient malnutrition but has been under-utilized by the European community.
- Consumer concerns and points commonly raised by European leaders regarding the safety of fortification have been addressed.
- When taken as recommended, folic acid reduces the risk of neural tube defects during pregnancy. An estimated 4,500 neural tube defects occur per year in the European Union.

Introduction

The theme of the prestigious 2012 European Health Forum Gastein policy event was "Crisis and Opportunity: Health in an Age of Austerity." The Flour Fortification Initiative (FFI), a network of public, private and civil sector partners, together with the International Federation for Spina Bifida and Hydrocephalus (IF), leveraged the opportunity to discuss flour fortification as a safe, cost-effective way to improve nutrition. Workshop topics included Europe's current nutrition environment; an overview of flour fortification; the economics of flour fortification; common concerns related to flour fortification; and neural tube birth defects, which can be mitigated by fortifying flour with folic acid.

Global nutrition concerns today

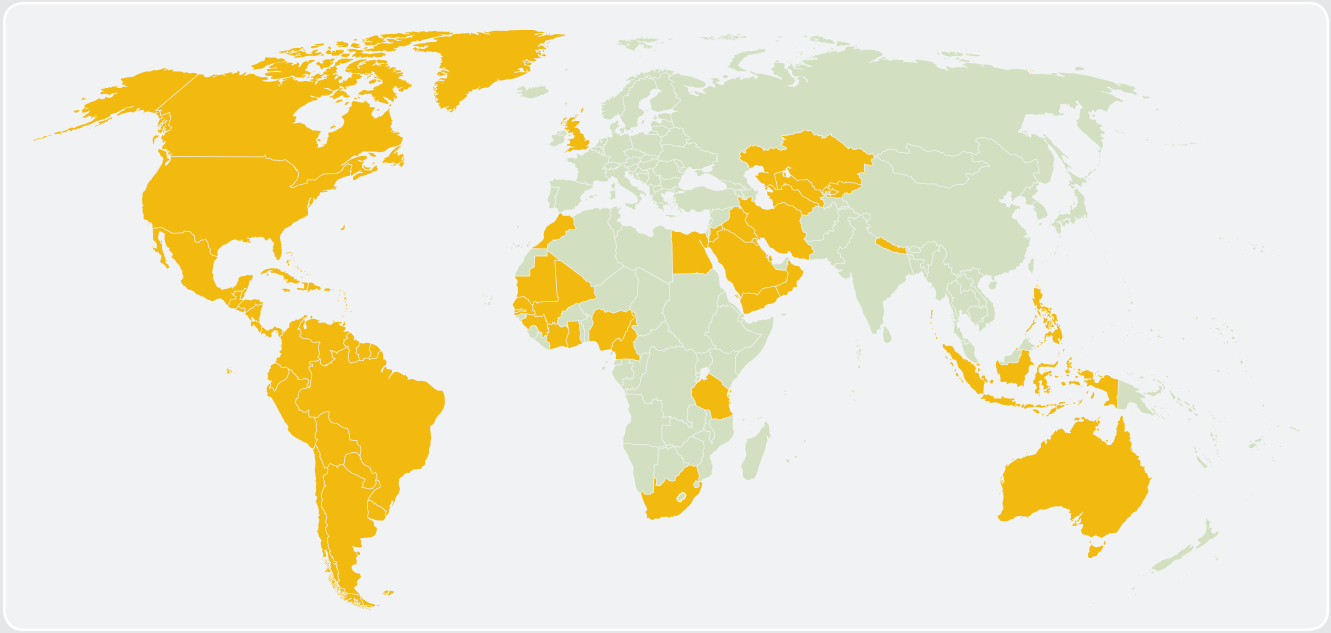
Worldwide, both developing and developed countries are struggling with two seemingly contradictory nutrition concerns – undernutrition and overweight.[1,2,3,4,5] Undernutrition is characterized by a deficient intake of energy, protein and/or micronutrients such as vitamins and minerals. Micronutrient deficiencies can affect the entire spectrum of a society, from those who appear undernourished to those who are overweight. This phenomenon is also called "hidden hunger," because deficiency symptoms are rarely apparent until individuals reach a clinically severe stage, at which point certain consequences may be irreversible.

Deficiencies in essential nutrients can increase one's risk for fatigue, anemia, birth defects, blindness, impaired growth, diminished neurological capacity, osteoporosis, and poor immunological response, among others. Each of these conditions has a negative impact on the quality of life of affected individuals and their family members. At a national level, nutrient deficiencies undermine the wellbeing of entire populations, creating a profound impact on healthcare spending and jeopardizing economic progress.[6,7,8,9,10,11]

Flour fortification in Europe

Many countries that affirm the value of prevention measures and believe in improving nutrition at a societal level use flour fortification as part of a comprehensive strategy to avert and address micronutrient malnutrition. In Europe, bread is a highly afford-

FIGURE 1: Countries with legislation for mandatory fortification of wheat flour



Note: All countries in orange fortify flour with at least iron and folic acid except Australia which does not include iron, and Venezuela, the United Kingdom, and the Philippines which do not include folic acid.

Source: The Flour Fortification Initiative, 2012

able and accessible staple food. If European countries choose to fortify flour, the majority of their populations will have access to more essential vitamins and minerals without necessitating behavior change.

> "If European countries choose to fortify flour, the majority of their populations will have access to more essential vitamins and minerals without necessitating behavior change."

The practice of adding nutrients to wheat flour to promote health and improve nutrition was initiated in the 1940s and 50s by countries such as the United Kingdom,[12] Canada and the United States of America.[13] This public health intervention is recognized internationally by many credible entities such as the World Health Organization (WHO), UNICEF and the US Centers for Disease Control and Prevention (CDC) as affordable, technically feasible, and effective. As **Figure 1** indicates, 75 countries currently possess mandates to fortify at least one type of commonly consumed wheat flour with iron and/or folic acid.[14] Notably, however, most countries in Western Europe have not embraced this initiative.

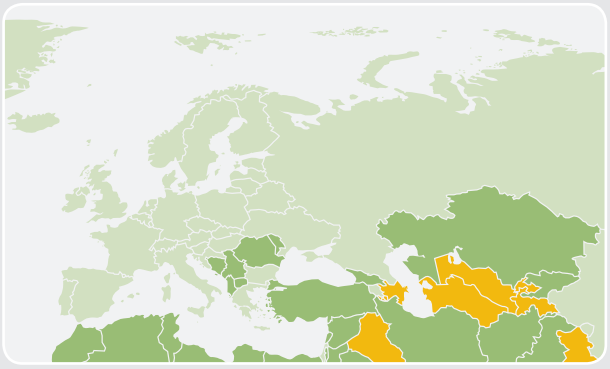
The European Health Forum Gastein policy event 2012

The prestigious European Health Forum Gastein policy event, which has been held annually for the last 15 years, brings together individuals representing the public sector, pharmaceutical companies, non-governmental organizations, the medical community, policy think tanks, and journalists for three days of high-level panels and presentations. The theme of the 2012 Forum was "Crisis and Opportunity: Health in an Age of Austerity."

The Flour Fortification Initiative (FFI), together with the International Federation for Spina Bifida and Hydrocephalus (IF), used the opportunity to discuss the importance of flour fortification during this time of economic hardship. The three-hour workshop was supported by well-known speakers from various fields, and moderated by Lieven Bauwens, Secretary General of the IF. The workshop included the following presentations and discussions:

> Nutrition in Europe – room for improvement;
> Flour fortification – overview and benefits to Europe;

FIGURE 2: Anemia as a public health problem by country: women of child-bearing age.



Category of public health significance (anaemia prevalence)

- Mild (5.0–19.9%)
- Moderate (20.0–39.9%)
- Severe (≥40.0%)

Source: Worldwide Prevalence of Anemia 1993–2005, WHO Global Database on Anemia

- Economic impact of flour fortification – cost to fortify versus cost to not fortify;
- Common concerns related to flour fortification; and
- Neural tube defects – the face of fortification.

Nutritional concerns in Europe

To begin the session, Dr Francesco Branca, Director of Nutrition for Health and Development at the WHO, described the nutritional concerns of European populations. Key challenges include obesity, excessive salt intake, consumption of foods high in simple sugars and saturated fats, and inadequate intake of fruits and vegetables. Though undernutrition is presently not a priority for many European governments, Dr Branca highlighted several well-documented and emerging concerns which, he urged, should be taken seriously.

> "Key nutritional challenges for European populations include obesity, excessive salt intake, consumption of foods high in simple sugars and saturated fats, and inadequate intake of fruits and vegetables."

European populations are not exempt from anemia. Using anemia in women of child-bearing age as the indicator, countries in Europe are classified mainly as having a mild or moderate public health problem **(see Figure 2)**.[15] However, the prevalence of anemia is often greater among pregnant women and preschool-aged children.[16]

Folic acid, when consumed appropriately before and during pregnancy, can decrease the risk of children being born with neural tube defects (NTDs) such as spina bifida or anencephaly.[17,18] Citing a 2011 study, Dr Branca showed that the intake of folic acid in many European countries is suboptimal **(see Figure 3)**.[19] He also noted that vitamin B_{12} and vitamin D deficiencies are emerging issues in the region.[20] Each of the nutrients cited by Dr Branca as lacking in the diets of European populations can be added to flour to address public health risks.

Nutrition and economics

At the conclusion of his presentation, Dr Branca discussed the relationship between economics and nutrition. In times of economic struggle, individuals are more likely to enter into a state of food insecurity which may compromise the quality – and possibly quantity – of food consumed. The resulting decrease in dietary diversity, increased consumption of low-quality foods and potentially smaller portion sizes jeopardize nutrient intake, which may lead to micronutrient malnutrition and related health issues.

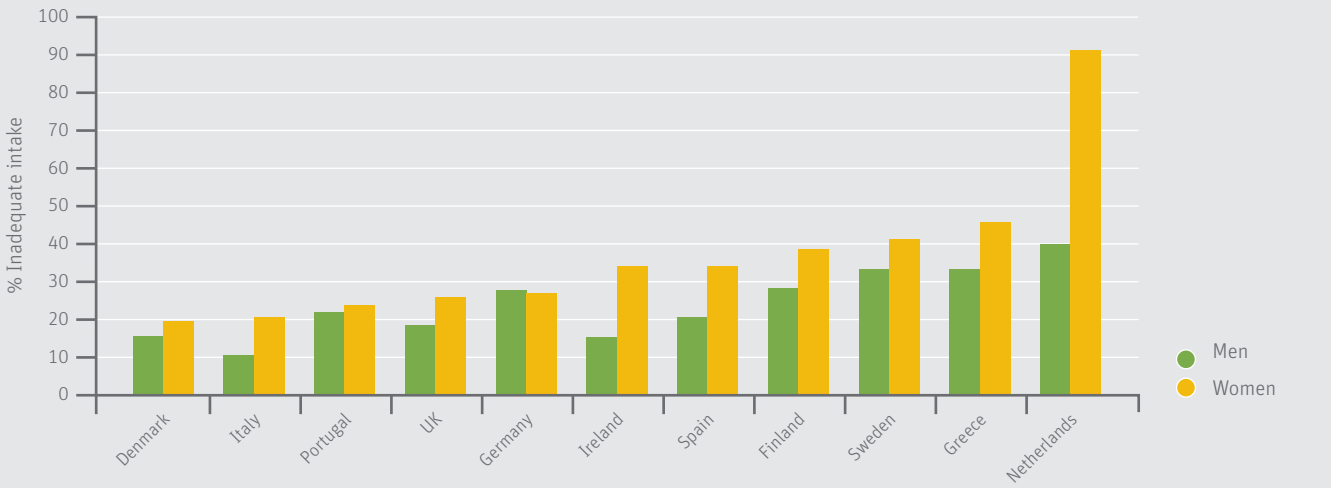
Similarly, low socioeconomic status, even during times of national economic progress, can impact food consumption patterns and therefore nutritional status. For example, a study in Lithuania found that children from families with low socioeconomic status (SES) were more likely to consume fewer servings of fruits and vegetables and more fast food than children from high SES families.[21]

Flour fortification: a wise investment

FFI Director Scott Montgomery emphasized that Europe is an ideal region in which to fortify flour given the high consumption of wheat flour-based products, a highly industrialized flour milling sector, and a strong transportation infrastructure. He provided an overview of the flour fortification process, flour fortification programs around the world, and study results that point to the positive health impact achievable through flour fortification. Mr Montgomery stressed the need to follow globally-recognized best practices when planning fortification programs. These include considering local food consumption patterns; assessing the nutritional needs of the population; conducting an industry analysis; creating a national fortification alliance that involves the public, private and civil sectors; and enacting mandatory legislation for flour fortification.

In the age of global austerity, flour fortification is a wise investment, noted Dr Sue Horton, Chair in Global Health Eco-

FIGURE 3: Inadequacy of folic acid intake in select European countries



Note: Inadequate intake of folic acid is indicated by the percent of the population consuming less than the estimated average requirement, listed as 200 µg/day for individuals aged 16–64 years.

Source: Viñas et al. Projected Prevalence of Inadequate Nutrient Intakes in Europe, 2011

nomics at the Centre for International Governance Innovation, and Associate Provost, Graduate Studies, at the University of Waterloo in Canada. Though industrialized countries initially led the development of flour fortification programs, recent progress has occurred mainly in developing countries. The Copenhagen Consensus Centre, a think tank that evaluates the most economically sound ways for governments and development agencies to allocate funding, ranked the provision of micronutrients as one of the top two priorities in 2004, 2008, and 2012.[22,23,24]

Dr Horton explored the costs of iron deficiency in comparison to the economic benefits of flour fortification. The cost-benefit ratio derived from a study using data from 10 developing countries with iron fortification programs was 1:8.7, meaning that for every $1 (US) spent on fortification, $8.7 were saved.[25] She added that the human costs associated with NTDs are paramount around the world. According to a 2011 review of multiple studies, the annual direct medical cost per spina bifida patient in the United States ranged from $11,061 in 1993 to $65,177 in 2003.[26] Related indirect costs, such as lost productivity and caregiver expenses, along with other direct non-medical costs such as special education, are rarely taken into account in studies.

Dr Horton stressed that flour fortification is a low-cost intervention. Though the annual cost of this intervention depends on the types of vitamins and minerals added to the flour, and the quantities of these necessary to achieve the desired health impact, she noted that the investment per person per year will usually amount to less than €0.16.

> "Despite the proven economic and health benefits of fortifying flour, concerns about flour fortification are still raised by governments and consumers in Europe."

Prevailing concerns

Despite the proven economic and health benefits of fortifying flour, concerns about flour fortification are still raised by governments and consumers in Europe. Dr William Dietz, former Director of the Division of Physical Activity and Obesity at the CDC, addressed these concerns by providing evidence on the following topics:

1. Mandatory flour fortification alone does not cause people to consume more than the tolerable upper intake levels of folic acid and iron.[27]
2. Folic acid fortification does not cause cancer[28,29,30] or mask vitamin B_{12} deficiency.[31,32,33]
3. Iron fortification poses no significant risk to individuals with disorders that impair iron regulation, such as thalassemia and hemochromatosis.[34,35] Individuals diagnosed with such conditions require appropriate clinical management to maintain their health regardless of whether or not flour fortification is implemented in a country.[36,37,38,39]

Given the vital role iron plays throughout the lifecycle, it would be negligent to withhold iron fortification from the greater population that stands to benefit.[40,41]

4. A targeted approach that urges women to take folic acid supplements before conception is less effective than the practice of fortifying flour with folic acid.[42,43,44,45]
5. Some consumer groups suggest that fortification will render bread impure. However, as the milling and baking industries have evolved over time to meet consumer demands regarding flavor, texture and longer product shelf-life, ingredients such as improvers and emulsifiers are now commonly utilized. Consequently, even unfortified bread often contains ingredients that, in the strictest sense, reduce the purity of the product.
6. Consumers can still choose unfortified products in countries with mandatory flour fortification because select types of flour and flour-based products are typically exempt from complying with the legislation.

The challenge of living with spina bifida

The workshop concluded with a presentation by Dr Margo Whiteford, Vice President of IF, and a consultant clinical geneticist. She began by outlining the various forms of NTDs and the importance of primary prevention strategies, namely the provision of folic acid through supplementation and flour fortification.[46] More than 4,500 pregnancies in the European Union are affected annually by NTDs, of which an estimated 72% are terminated.[47] During the second half of her presentation, Dr Whiteford helped the audience to better understand the complexities of spina bifida by sharing pictures and stories documenting her own life, as she was born with the disability. Although an uplifting account of personal determination and accomplishment, Dr Whiteford's presentation also drove home the fact that living with spina bifida is not without challenges. Children born with this defect can live fulfilling lives with the proper physical and emotional support, but they remain at risk of developing hydrocephalus, paralysis, pressure sores, and incontinence – surely, a high price to pay when simple prevention measures, such as flour fortification, can dramatically improve pregnancy outcomes.

For more information:

Please visit FFI's website at www.ffinetwork.org. To learn about IF's work to support individuals and families around the world whose lives are affected by NTDs and hydrocephalus, please visit www.ifglobal.org

Presentations from the workshop can be viewed at:

www.ffinetwork.org/about/calendar/2012/calendar_Gastein.html

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A Framework for Shifting from Universal Vitamin A Supplementation

Technical Consultation on Guidance for VAS Programs for Children 6 – 59 Months of Age, Ottawa, February 2012

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Vitamin A supplementation has been shown to save young children's lives in contexts where vitamin A deficiency is highly prevalent. Since the 1990s, vitamin A supplementation (VAS) has been implemented successfully in such countries around the world. In a recent review, the World Health Organization (WHO) renewed its previous guidance for vitamin A supplementation for all children 6–59 months of age in populations where vitamin A deficiency (VAD) is a public health problem – a situation that persists in many developing countries. The guidelines reaffirm the high mortality impact of VAS, and therefore its importance as a child survival intervention in the relevant contexts .

Over the last 10 years however, many middle and some lower-income countries have made great strides towards improving the regular consumption of sufficient quantities of vitamin A – even among young children – utilizing varying combinations of dietary diversity, food fortification and the implementation of other programs to prevent micronutrient deficiencies (for example, micronutrient powders and lipid-based nutrient supplements). If dietary intake is sufficient over a sustained period, universal vitamin A supplementation becomes unnecessary and should not continue, for both safety and cost-efficiency reasons. Guidance is certainly needed to identify where dietary intake of vitamin A is sufficient and where it is not – and to thus support country-level decision-making related to the ongoing need for universal supplementation. Where universal supplementation is deemed unnecessary, a shift to targeted supplementation of high-risk sub-groups of the population, or complete phase-out, should be considered. Such guidance, however, goes beyond the mandate of the WHO evidence reviews. The challenge is to ensure that decision-making related to VAS targeting or phase-out is based on reliable evidence of improved vitamin A intake and status, and clear identification of any vulnerable sub-groups that might still be at risk of deficiency within a population.

To review the evidence base for, and to develop such guidance, a two-day technical consultation was organized by the Global Alliance for Vitamin A (GAVA) partners and hosted by the Micronutrient Initiative (MI) in Ottawa, Canada, from February 7–9, 2012. The consultation brought together a small group of academics and experts on the implementation of vitamin A programs. The objective of the consultation was to generate clear and concise programmatic guidance, and to lay out a framework that could be used by governments to review their vitamin A supplementation programs. The defined framework takes into consideration information on sources of vitamin A in the diet, evidence of deficiency (e.g., serum retinol data), the existence of strategies likely to increase vitamin A intake (e.g., fortification) and diversity in these factors among population groups. Trigger points within the framework will guide users to an evidence-informed decision as to whether they should continue vitamin A supplementation on a national scale (children 6–59 months of age), target children in that age group using specific criteria (e.g., geographic targeting criteria), or begin program phase-out.

The framework has been developed with the support of experts in vitamin A nutrition, program design, and survey de-

THE GLOBAL ALLIANCE FOR VITAMIN A (GAVA):

CDC, CIDA, HKI, JHU, MI, UNICEF, USAID, WHO

GAVA Technical Consultation on Guidance to Vitamin A Supplementation Programs for Children 6-59 months of age

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sign and sampling, among many other relevant areas. The draft framework will be tested in countries with diverse vitamin A status, intake and program types and will be adapted as necessary to ensure its ability to help identify such diverse situations and potentially high-risk groups. A policy brief and detailed framework with guidance will be finalized following testing, and is expected to be released by early 2014.

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Addressing the Double Burden of Malnutrition: The Summer School of International Nutrition

September 23–29, 2012, University of Potsdam, Germany

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Introduction

Food insecurity is still a challenge in much of the world – especially in developing countries – and while global efforts to eradicate hunger in all its forms have garnered some success, 450 million children will be in danger of stunting in the next 15 years. "Hidden hunger" – or the deficiency of essential micronutrients such as vitamins A and D, iodine, iron and zinc – threatens millions of people worldwide, even in developed economies, and creates a vicious cycle of loss of adulthood productivity, perpetuating poverty.

On the other hand, we are faced with an increase in non-communicable diseases (NCDs) such as diabetes, cancer, hypertension, metabolic syndrome, coronary heart disease, stroke and obesity. Paradoxically, NCDs are the largest single cause of mortality in the world, responsible for more than nine million preventable under-60 deaths. NCDs affect both developed and emerging economies, and developing countries in particular need to establish and implement appropriate programs to target these problems.

The Summer School of International Nutrition, held from September 23–29 in Potsdam, Germany, was established to address global undernutrition, overnutrition and comorbidities by gathering ideas from nutritionists, academicians, clinicians, NGOs and industries.

For the first session, 40 representatives from 23 countries across Europe, Africa, South America and Asia were selected to participate. The course consisted of lectures on the many aspects of malnutrition and its complications across the world, and workshops that functioned as think tanks to help find solutions to these problems. Participants were split into groups according to region (Africa, Europe, Asia, and South America). Solutions proposed during the workshops for one region were shared and discussed with representatives from other regions to assess their effectiveness and feasibility.

Objectives

The Summer School of International Nutrition aimed to find integrative solutions to global malnutrition. Its specific objectives were to:

- understand the physiology of micronutrient deficiencies and NCDs;
- assess the extent of damage done; and,
- learn from previously implemented programs and develop new solutions to address both micronutrients deficiencies and NCDs.

Framework of the course

A. Introduction to the problem of malnutrition in the world

The course began with an overview of malnutrition, which refers to both undernutrition and overnutrition. More than two billion people are suffering from hidden hunger globally, and more than two million children are dying due to undernutrition-related causes. Paradoxically, ever more people are dying from obesity and related disorders.

The term "undernutrition" encompasses hunger, food insecurity, global undernutrition and micronutrient deficiencies. The

most vulnerable groups are pregnant and lactating women, and young children. The causes of micronutrient deficiencies are numerous, and range from insufficient dietary intake and/or nutrient losses incurred through disease, to physiological status changes. However, unsuspected causes such as monoculture and sanitation were also underlined.

Overnutrition refers to overweight, obesity and "horizontal growth" measured by waist circumference and a body mass index (BMI) over 25 kg/m². The increasing prevalence of non-communicable diseases can be attributed to global lifestyle changes including urbanization, population growth, globalization, climate change, migration, food and energy insecurity, overeating and lack of physical activity. NCDs are the leading cause of death on all continents except Africa, with 36 million people dying NCD-attributable deaths annually.

B. Workshops

During the workshops, two areas were focused upon: micronutrient deficiencies and non-communicable diseases. For each area of concern, causes and consequences were defined, and solutions proposed. These included direct and indirect causes, and immediate and long-term consequences. Solutions suggested encompassed education, public health and policy changes, and were proposed at community level as well as national level.

Lessons learnt

The fight against micronutrient deficiencies has proven a paramount success worldwide. Mandatory food fortification and supplementation have improved the iodine, iron and vitamin status of populations worldwide, even in remote rural areas. However, during the workshops, multiple micronutrient deficiencies and relapsing infections were pinpointed as a cause of slowing progress in this area.

Furthermore, the workshops revealed that ignorance, poverty and lack of hygiene continue to jeopardize the reduction of micronutrient deficiencies. The Summer School underlined the importance of breastfeeding, consumption of fortified foods, food diversification and improved hygiene in addressing micronutrient deficiencies. Regular physical activity, screening of vulnerable groups, and education should all be fundamental in the fight against malnutrition. Additionally, leaders must commit to establishing sustainable strategies for combatting micronutrient deficiencies and non-communicable diseases.

Genetics play a key role in incidences of obesity and other non-communicable diseases. Epigenetic changes are also implicated in the global epidemic of obesity. However, global trends including sedentary routines, overconsumption of processed foods, smoking and alcohol abuse all contribute to obesogenic lifestyles. As indirect causes, urbanization, the nutrition transition and pollution all impact the increase of NCDs. The Summer School recommended the promotion of sports and an active lifestyle, clear food labeling and regular medical screening to combat NCDs.

Moreover, the workshop proceedings revealed the importance of education and sensitization in the fight against malnutrition. Governments and country leaders are encouraged to provide enabling environments and adequate legislation for food fortification and labeling. NCDs and micronutrient deficiencies must be highlighted in national health strategies.

Conclusion

The Summer School made it possible to bring together diverse ideas and thinking regarding the causes and consequences of, and solutions to, global malnutrition. Significantly, the solutions proposed can be implemented at individual, community and national levels in the quest for a world free of malnutrition and related diseases and disorders.

Acknowledgements

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Report from Guatemala

Aldea Maya: Promoting Better Nutrition

Louise Sosa
Aldea Maya

Aldea Maya is a non-profit grassroots organization working in the Guatemalan highlands to help indigenous Mayans improve their lives through education, nutrition, home farming and micro-loans. Here, Canadian-born Aldea Maya's spokesperson Lousie Sosa – who has worked for the cause for over five years, and who carries out fundraising for the organization in her hometown of Qualicum Beach, Vancouver Island – shares details of some of Aldea Maya's work with *Sight and Life* readers. In recent years, this work has focused especially on the inhabitants of the village of Chukumuk, who are survivors of one of the region's worst catastrophes.

Nestled in the highlands of Guatemala sits the new village of Chukumuk. Its inhabitants are survivors of one of the worst natural disasters in Central American history, the 2005 Panabaj Mudslide. This mudslide killed hundreds of Mayans, leaving many more without families, homes and belongings.

Fortunately, however, there have been some positive developments following this disaster. The survivors have all received new cement homes with small yards, built in an area safe from similar future disasters, and the Spanish government has supported the construction of an excellent elementary and high school facility in the new village. Despite this, the problems that plague most developing countries, and particularly the highlands of Guatemala, continue to occur.

Most families live a hand-to-mouth-existence, not knowing from day to day where the money for their next meal will come from. Very few of the villages' inhabitants are educated, and many members of the older generation speak only the local Mayan dialect, making it impossible for them to find jobs providing decent wages. The problem is compounded by a high percentage of single-mother families. In Chukumuk, the number of single-mother (or grandmother) families is particularly high as a large percentage of local men died in rescue efforts during the mudslide.

To earn a living, village inhabitants produce beadwork and weaving, and work on coffee plantations. However, money is tight for a majority of families, and the main meal of the day typically consists of little more than a corn tortilla with salt. Foods that provide protein – such as meat or poultry – and fruits and vegetables, are considered a luxury. Due to this extreme lack of nutritious foods, particularly during children's formative years, stunted growth is a common occurrence in the area.

Aldea Maya has been working with local survivors for the last five years to improve their nutritional and economic status. One of Aldea Maya's founders is a dietitian and teacher, so a primary focus has been practical nutrition programs targeting elementary school children. An example of these programs is the Grade 3 Papaya Plant program, which has been in operation for three years now. As part of this project, each Grade 3 student learns about the importance of vitamins A and C. Using engaging visual aids, children are taught why they need to consume these two vitamins. As eight- and nine-year-olds tend to have short attention spans, their interest is maintained by involving them in fun activities such as cooking classes. Students participate in simple activities such as making melon and papaya smoothies. These smoothies are often the first blended drink that a child has ever tried, and are considered a real treat!

Aldea Maya also provides each student with a handout listing foods rich in vitamin A and C. As most mothers are illiterate, these handouts contain mostly pictures and very few words. Aldea Maya purchases these foods from the local market to make them available to villagers. While there is a large range of vitamin-rich foods available in the local market, when one factors in that over 70,000 people use this market, it becomes clear that there really is very little nutritious food available, and that very small amounts of it are bought per family.

Students receiving their papaya plants and organic compost.

As part of the program, each student also receives a healthy papaya plant and a bag of organic compost. Students are then taught how to care for their plants. This part of the program has evolved over time – during the first year of the project, several young papaya plants were destroyed by animals or stray soccer balls. Now, Aldea Maya workers ensure that children have collected materials with which to build a protective cage for young plants several weeks before they receive their plants.

Several students have achieved amazing results with their plants, as is evident from pictures of the papaya plants taken at year-long intervals. Not only does this project add a vital source of vitamin A and C to families' diets, it also increases a family's income, as extra papayas can be sold or traded.

Aldea Maya also provides Grade 2 students a banana plant each, as well as very basic nutrition and cooking classes. This program was started in September 2011, and the plants were producing bananas as early as four months later! Grade 4 students learn to use soda bottles and toilet paper rolls to make mini greenhouses in which they grow fruits and vegetables, and Grade 6 students are taught about folate, and how folate deficiency is linked to neural tube defects. They also receive cooking classes and are given a citrus tree each.

This approach by Aldea Maya gives students the necessary nutrition information to make healthy food choices and the resources to make those choices a possibility.

For more information on Aldea Maya's work, please visit:
www.aldeamaya.ca/

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Sources:
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Report from Nepal

Improving Nutrition for Carpet Factory Workers' Children

Mahendra Chalise
General Secretary, Helpless Rehabilitation Society, Kathmandu, Nepal

Malnutrition affects the children of many carpet factory workers in Nepal

Introduction

This report presents the results of a year-long project, supported by *Sight and Life* and implemented by the Helpless Rehabilitation Society (HRS) from November 2011 to October 2012 in the north-east of Kathmandu, the capital of Nepal. The project targeted preschool-aged children between 2–6 years old from among indigenous, underprivileged groups of Nepalese carpet factory workers, and its major objective was to improve their nutritional status and prepare them for school enrollment by creating awareness amongst factory owners and mothers.

According to the Ministry of Health, malnutrition is a serious concern in Nepal. Half of all children under five years old are stunted or chronically undernourished, and acute malnutrition rates are at 13%. Extreme variations are also masked by this national average, and in many communities, acute malnutrition rates exceed 15% – the emergency threshold – threatening millions of children with debilitating and irreversible mental and physical impairments.

Specific objectives of the project included advocacy among the carpet factory owners and public health personnel; organizing a day care center; providing each child with a nutritious mid-day meal; arranging bi-monthly health camps and nutrition education for mothers; finding sponsorship for the children's school enrollment; and assessing knowledge, attitude, and behavior (KAB) of mothers about child nutrition and well-being before and after the intervention.

Methods and outcomes

A total of 100 preschool-aged children between 2–6 years of age from among 20 carpet factories within the suburban area of Kathmandu valley were targeted. Priority was given to female children, large families and/or single-parent families, low-income families, and indigenous groups.

Mothers, adolescent girls and carpet factory owners were considered secondary target groups, and were involved in every aspect of the project. To achieve the project's objectives, the following activities were implemented:

› *Meetings with factory owners*

Four meetings were organized over the year with the owners and union leaders of each participating factory. The first meeting served as an introduction, and the second and third served to share progress and encourage support. Despite initial resistance, factory owners eventually agreed to support the program after assurances by union leaders, and in light of previous successful HRS activities.

› *Establishment of Early Childhood Day Care Centers (ECDC)*

Day care centers catering to two age groups were set up. A play group for children from 2–3.5 years old drew 55 children, and an educational group for 3.5–6 year-olds comprised of 45 children. As a result of frequent dropouts and new enrolments, however, the number of children attending the day care center differed each month. Eighty-six children in total benefited from the project.

A day care center for the children of carpet factory workers in Nepal

The program endeavored to make these centers accessible to children from all participating factories. Each center was managed by a coordinator, two teachers and one female childcare provider. Activities were closely monitored by the Program Director and the executive board was briefed every month.

› *Nutrition education for mothers*

Discussions on the care of under-fives were organized every two months to coincide with the children's medical examinations. Mothers were taught about selection and preparation of food, the importance of vitamin A rich foods and of administering vitamin A capsules, and seeking medical help for sick children.

› *Anthropometric examinations*

Children were screened by a doctor every two months for health problems including micronutrient deficiencies. Their anthropometric data (e.g., height and weight) was also recorded and tracked, and necessary care suggested accordingly.

During an eleven-month period, 45% of children grew 2–4 centimeters, 52% grew 4–6 centimeters and 2% grew by six or more centimeters. Also during this time, 5% of children gained less than 3 kg, 42% gained 3–9 kg, 48% gained 6–9 kg and 5% gained over 9 kg.

› *Medical examination*

A total of five medical checkups were organized for children during the project period, with health camps held every two months. These checkups included eye, ENT and dental examinations. Minor problems were treated locally while those requiring further treatment were referred to suitable health facilities. The most common health concerns included ear, eye and dental complaints, colds, respiratory issues and malnutrition.

› *Midday meals*

Children were fed one nutritious meal at school every day. These meals were prepared using locally available ingredients and consisted of: porridge with spinach and carrots (three days a week), rice pudding (two days), and chicken/mutton fried rice (one day). Mothers were encouraged to visit during mealtimes and shown how to prepare these foods.

› *Healthy baby contest*

A healthy baby contest was organized three times during the year. Children were assessed by a team, including a medical doctor, on their health and the cleanliness of both mother and child. Factory owners, local authorities and media representatives were invited to these events to raise awareness.

Bimonthly checks on height and weight help to shape care recommendations for each child

› *Knowledge, attitude and behavior study:*

A knowledge, attitude and behavior (KAB) survey regarding child nutrition and well-being was carried out among the mothers of participating children both before and after the program. Results were then compared. Respondents were found to be mostly young mothers, with 62% being 21–30 years old. Fifty-one percent had their first child between 21–25 years old. Literacy was low, with 44% literate and 35% illiterate.

A comparison of pre- and post-program survey results showed that beliefs in certain areas remained largely unchanged. For example, there was no significant change in mothers visiting health centers and eating well during pregnancy, or opting for hospital births. However, other areas showed improved awareness, such as the need for immunization (from 70% to 80%), medical treatment for sick children (from 37% to 87%), and initial breastfeeding (from 88% to 99%). Nutrition awareness increased dramatically, including causes of malnutrition, nutrient-rich foods, medical treatment for malnutrition, and so on.

Conclusion

In Kathmandu Valley alone, there are approximately 800 carpet factories staffed by underprivileged migrant workers. Many of these are women who, when they return to their native districts, will share with others the lessons they have learned regarding childcare and nutrition.

This program has attempted to change attitudes towards health and education, demonstrating their importance not just for individuals, but for communities and businesses. Mothers are better equipped to care for their children, especially under-fives, children in the program have shown marked behavioral improvements, and migrant communities feel a new sense of support. HRS will share the outcomes of this program with all concerned stakeholders and government authorities in an attempt to replicate this program in other districts.

Among the program's strengths are that it can be managed entirely by HRS; many factory owners now support the program; local schools are keen to enroll children recommended by the ECDC, and organizations are willing to support them; and workers can be more productive once the burden of childcare is lifted. Weaknesses include a high drop-out rate of children due to parents' transfers, a lack of trained teachers, and a lack of post-ECDC school enrolment.

However, there are many opportunities to further this program including motivating factory owners to provide rent for the ECDCs, involving donors and local schools with child sponsorship, and abolishing child labor. While high staff turnover and political instability in Nepal may be threats to the program, with continued support from *Sight and Life*, there is a great deal we can accomplish.

Acknowledgements

We extend our sincere gratitude to Dr Klaus Kraemer of *Sight and Life* for supporting this project. We are also grateful to the carpet factory owners for their generous support, and to union leaders for their belief and participation in the program.

Special thanks to all mothers who participated in the KAB survey and sent their children to the early childhood development center – without their involvement, this program would have been impossible. We also thank government authorities, executive board members, doctors and ECDC staff for their unflagging support.

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Report from Haiti

Teaching to Fish: The Akamil Production Facility is Deemed a Sustainable Project for the Rural Community of Thomonde

Jennifer Browning-Peters
Project Medishare, Washington DC, USA

Introduction

In early 2007, Centers for Disease Control (CDC) Senior Fellow Michael Kaiser met with Project Medishare to brainstorm how to produce an indigenous food called Akamil (pronounced Ah-kah-mil) on Haiti's remote Central Plateau. With the combined support of Project Medishare, the Ministry of Health and numerous Haitian business leaders, an Akamil production facility has now become a reality.

A project for the whole community

After the CDC had originally agreed to provide technical assistance for the project, but then the CDC's funding was cut in 2011, Medishare hired Michael Kaiser directly as the project's coordinator. Kaiser, who describes himself as a 'community organizer' and has been affectionately called the 'Godfather of grass roots' by his colleagues at CDC, sees the Akamil project as a *grassroots campaign* to support Project Medishare's mission in Haiti.

"A grassroots intervention such as this has the value of creating jobs for farmers, jobs for plant workers and jobs for women in the sale and distribution of nutritious, affordable food." Kaiser explains: "In Haiti, people prioritize job creation much higher than nutrition, so what we have done is to create a *holistic* intervention that addresses nutrition, but at the same time creates jobs for people locally to stimulate the local economy. We are doing something Haitians want to do and making something Haitians want to eat, not something the international community is trying to make them do or eat. Akamil is an indigenous food that Haitians already know and like."

A fully nutritious, staple food

Akamil is made from locally grown beans combined with any grain, particularly wheat, rice or corn, as long as it maintains a 70:30 ratio of grain to legume. Haitians like to mix Akamil with fruit and sugar for a sweet meal and/or mix it with vegetables and salt (and meat, when available) for a more savory, substantial meal.

Akamil has typically been something Haitians buy from street vendors on market days. It has always been too expensive to make at home because of the high price of charcoal and lengthy cooking time required to cook the food for a full 30-40 minutes in order to destroy enzyme inhibitors and other toxins in the beans. However, Medishare's new Akamil plant pre-cooks the food by running it through an extruder, so all a customer needs to do is boil water, in much the same way instant oatmeal is prepared.

Medishare's *instant* Akamil will be sold and distributed in re-sealable, reusable, eco-friendly packaging.

"The cooking time has been reduced from more than 30 minutes to less than three minutes," Kaiser explains, "and needing less charcoal to cook the food means fewer trees need to be cut down from Haiti's already depleted forests. It's a staple food everyone can afford, plus it's fully nutritious. This is a project 'for Haitians, by Haitians.' All we are doing is following their lead and providing technical assistance. If anything, the Haitian people are teaching us how to do an intervention correctly."

> "They are teaching us how to do an intervention correctly in Haiti."

School feeding programs and plant expansion

The sale and distribution of Akamil won't be limited to Haiti's Central Plateau. The Haitian Government and several international aid organizations have already said they want to buy Akamil for school feeding programs in their own countries. And, thanks to the enormous support this grassroots campaign has received in Haiti, the Akamil plant will have no overheads, so it can produce the food at-cost, making it extremely affordable, even for the poorest of the poor.

The plant will be run as a not-for-profit business, not as an NGO. Project Medishare has agreed to follow a strict business plan so additional plants can be built as not-for-profit *franchises* to benefit other Haitian communities.

Michael Kaiser (extreme right) with the full installation team

Already two communities have said they want to build their own Akamil plants. Medishare's business plan will give them the roadmap they need, including all the information they need to maintain quality control standards – for example, how to source the most suitable packaging and labeling, and how to achieve the prescribed vitamin-mineral premix.

> "The premix contains all of the essential micronutrients recommended by WHO's Global Guidelines to make a complete formula that can be consumed by the entire family."

Partners and donors

One of the many donors to the Akamil campaign in Haiti has been DSM. The company developed and donated a vitamin-mineral premix that contains all of the essential micronutrients recommended by WHO's Global Guidelines to make a complete formula that can be consumed by the entire family.

DSM originally became involved in the Akamil campaign through AzkoNobel. Business Manager of AzkoNobel Geoff Smith agreed to donate Ferrazone® (sodium feredetate, an iron compound used for the treatment of iron-deficiency anemia). He then contacted DSM to see if they would donate the rest of the vitamins and minerals needed.

Social responsibility

Marienella Mendez, DSM's Commercial Manager for Human Nutrition and Health (HNH) for Latin America, toured the Akamil facility with Michael Kaiser in October 2010, while the plant was still under construction.

"We wanted to participate in the complete process to be sure that the premix would be used in the right way," Mendez says. "We have a social responsibility with our products. We need to make sure the people taking these vitamins are absorbing them in the right way. We also have the responsibility to ensure that the product is being used correctly. In order to obtain the right product, we're helping to make sure that the vitamins and minerals are created at the right levels."

In addition to the generous donations from DSM and AkzoNobel, Quest Diagnostics donated HemoCues® for local testing of blood/hemoglobin levels, and the employees of Carestream Health, Inc. donated $39,000 to cover the cost of training local

TABLE 1: Akamil ingredients

Akamil ingredients	
Cereal (rice, corn, millet, wheat), legumes (beans) and formula premix	Fortified with a mix of important vitamins and minerals such as iron, zinc, and vitamin A.

Hammer mill, mixer and extruder on the plant floor

community health workers so that they could conduct a local nutrition survey and collect data. This is noteworthy because it means that for the first time Haitians will be collecting their own nutrition data rather than relying on the international aid community to collect it for them.

> "For the first time Haitians will be able to collect their own nutrition data rather than relying on the international aid community to collect it for them."

Instant access to information

Two Texas companies donated state-of-the-art computer hardware and software to the Akamil campaign to enable local community health workers to collect data electronically, despite this being a part of Haiti with no electricity.

Nutrition data can now be made available to doctors at local clinics to keep them in the loop so they know exactly which children need immediate attention. In addition, the electronic survey platform means women and children participating in the baseline survey will now have *Electronic Medical Records* – another first for the Central Plateau. Better still, this donated computer hardware and software can be used for other research / data collection on the Plateau. According to Kaiser, surveys for malaria and other infectious diseases have already been planned.

"Of course, it's not just having access to state-of-the-art hardware and software that's key," Kaiser notes, "it's also having trained, capable community health workers who know how to use the equipment and who are willing to develop the survey methodology. We've found Medishare's community health workers more than capable. All they needed was the equipment and a little bit of coaching. I am really amazed by the job Project Medishare is doing here. Medishare is motivating Haitians to do things by themselves. This is involving the local community, civic organizations and private industry, all working together on a project that has real sustainability. It is difficult to find projects like this."

Kaiser believes that the most important thing is just having access to public health information in a more timely fashion: "Now the Ministry of Health won't have to wait two or three years for data as has often been the case when the international community is responsible for doing a nutrition survey. The data will be available the same day and, as stated, Haitians will be collecting it themselves. So you see, we really are taking this concept of *'Don't give them a fish; teach them to fish'* to heart in everything we do."

> "The grassroots approach is very cost-effective when people understand that it is their own problem, they will try to solve it themselves and they will find the resources locally."

A successful grassroots effort in a 'problematic country'

Kaiser has led grassroots campaigns in other countries. His theory is, the more 'problematic' the country, the greater the chance for success when using this grassroots approach. Haiti is a great case in point.

"When we started in Haiti, our colleagues at CDC, USAID and UNICEF all suggested we try a more traditional intervention," Kaiser explains, "but when we talked with people locally they were determined to try something new: fortify an indigenous food. It's a much better idea, especially considering many of the traditional interventions had already been tried in Haiti and had failed. Rather than always pulling the same old interventions off the shelf, we need to recognize when something isn't working and dare to try something different.

"To my colleagues at CDC, I used to say, 'we must not only think outside the box, but recognize that we are the box!' To find real innovations we must look locally, and nobody knows

the local community better than those living in that community. Why would you try an intervention from another country? That's a colonial way of thinking. I can't believe we still do interventions that way, but we do. So when something isn't working, dare to try something different, even if it's never been done before. That's common sense, and that's what the grass roots approach is all about."

> "We're putting the onus back on the communities. That's what the grassroots approach is designed to do."

"If you focus on a single community rather than the entire country and create a *model*, you will find that other communities will follow," says Kaiser, "and if you have one successful intervention, I guarantee you other communities will follow suit, and your growth rate will be exponential, because nothing spreads like success.

"Best of all, it doesn't cost anything when communities copy one another. They do so not because they have to, but because they want to. Success is not only sustainable, it's also very saleable. We're putting the onus back on the communities; that's what the grassroots approach is designed to do. It costs less, is more sustainable, it builds self-sufficiency, and it improves government relations in these developing countries. So it's not only better for the developing countries, it's also better for the international aid community."

Volunteers and donors where they say there are none

In Haiti, critics argued that the grassroots approach would never work because the country was too poor.

"Not true," Kaiser says. "It will be the biggest success to date." Of course, Kaiser credits local Haitians for that success and explains that none of it would have happened without local buy-in.

"When Medishare needed bricks and mortar to build a plant, it was local business leaders in Haiti who stepped up and donated the bricks, the metal roof, floor tiles, paint, and other building materials. When we needed a diesel generator to run the plant, PowerSecure [Wake Forest, NC] donated a generator and sent an electrician to Haiti to install it. When we realized we needed more water than we had available locally, AutoGov's CEO made a personal appeal to his friends and neighbors and raised money to dig a well so fresh water could be available not only for the plant but for people living near the plant. And when food processing equipment was needed to equip the plant, it was students at the University of Miami's Rotaract Club who raised $20,000, which was then matched by the Rotary Clubs of South Florida and Rotary International in Chicago.

"So to those who say you can't find donors and volunteers in poor countries because there's no history or culture of giving, it isn't true. They just don't know how to attract donors and volunteers. People will come out of the woodwork in support of a good grassroots campaign in any country if they are inspired and believe in the campaign. In Haiti, it just took a handful of Haitian business leaders and a group of university students to provide the inspiration and get the ball rolling."

The single biggest contributor to Medishare's grassroots campaign in Haiti was Curt Bergfors, President of Max Corporation of Sweden. Curt donated $500,000 to build a training center and dormitory, which sits immediately adjacent to the Akamil plant.

Kaiser's list of donors goes on and on. However, it's worth noting that all of these donations came from personal appeals to friends and family, civic groups, small businesses, private corporations, and foundations. None of the money came from international aid organizations or governments.

"Where there's a will, there's a way," Kaiser contends. "The important thing is just to believe in what you are doing and have faith that you can accomplish your goal. That's the difference between a grassroots, bottoms-up campaign and a top-down, international aid intervention. We rely on faith and hope and truly believe people will come together for a common cause, but it all starts with trust, which is something noticeably absent from many international aid interventions.

"Where they see people as statistics, we see real names and faces. That's what motivates people locally and why they become personally committed, come hell or high water."

"In Haiti," Kaiser adds, jokingly, "we have both."

Of course a grassroots campaign will have different outcomes in different places.

"This isn't 'one-size-fits-all'; in fact, just the opposite," Kaiser continues. "It's tailoring an intervention and working one community at a time. The only thing that's the same is local leadership and local participation. Much depends on what the local community wants to do. All we have to do is listen. But then, that's not something the international community is very good at either. Just remember, there's no such thing as a bad idea … only bad coaching."

A new paradigm for foreign aid

Michael Kaiser considers these grassroots, *holistic* interventions as the new paradigm for international aid because they make the most sense for people locally as well as for the international aid community.

"It's admirable that so many wanted to 'help' Haiti after the earthquake," he explains, "but when the international community steps up, the local community steps back. The first step simply needs to be education. Then brainstorm with the people

The first batch. From left to right: Michael Kaiser, Project Medishare, Akamil Plant Coordinator; Dr. Hans Legagneur, Haiti Ministry of Health; and Dr. Faidherme Casseus, MD, Project Medishare

locally to find out what they want to do. Hopefully, you will come up with something that benefits the community and can be a model for other communities. After that, launch your grassroots campaign and start beating the bushes for dollars.

> "When the international community steps up, the local community steps back."

"The role of the international community is simple. Act as a coach and provide technical assistance in the field. But remember, they are the players in the field, not you! It's their game. They need to score the winning goal and be allowed to take credit for that goal, not international aid organizations. Again, share what's been done in other countries, but ultimately the intervention needs to be crafted locally and led locally; that's the only way you are ever going to make it sustainable and achieve self-determination.

"With international aid dollars drying up at the very same time we see food and water shortages increasing, along with the effects of global warming and an escalation in global terrorism, we had better start thinking about a new paradigm for foreign aid. People locally will always support a grassroots campaign if it's in their best interests. But the only way you can communicate that successfully is locally."

Today

Although initial work began on the Akamil Production Facility in June 2007, its construction and final equipment installation were delayed by the January 2010 earthquake and the cholera outbreak that followed in 2011 and 2012.

However, with the completion of the facility and successful trials last fall, its impact will be significant once full-scale production begins in the second quarter of 2013. Currently, Project Medishare is making one last fundraising push to obtain the necessary start-up funds to buy raw materials and hire local staff to operate the plant.

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Sight and Life Sponsors Community Service Award

Stacy-Leigh Samuels
Stellenbosch University, South Africa

Stellenbosch University award winner Stacy-Leigh Samuels with Community Nutrition lecturer Liesbet Koornhof.

My name is Stacy-Leigh Samuels and I was born and raised in a small town called Uitenhage in the Eastern Cape in South Africa. A little over four years ago, I realized that I had a passion for helping people in any way possible, and so, I decided to study Dietetics. I have never looked back. Being a dietitian allows me to work with people on a daily basis to do what I can to improve their health and well-being through nutrition.

I was privileged to be rewarded for my hard work and dedication during my final year of study as I received awards for the Best Final Year Dietetics Student in Nephrology, Nutrition Education and Health Promotion and Community Nutrition (the latter was sponsored by *Sight and Life*), as well as the Rector's Award for excellent academic achievement. During my four years of training, I realized that dietitians play an important role within a community – from the promotion of breastfeeding, to the prevention, treatment and control of malnutrition in adults and children.

During my practical year, I was able to gain a great deal of experience working within the community, and was able to contribute towards the hospital I worked at reaching the important milestone of "baby-friendly status." I spent a lot of time educating pregnant women about why "breast is best," as well as motivating them to breastfeed. I also supported postnatal mothers by showing them how to position their baby on the breast, ensuring it latched on correctly – critical to ensuring successful breastfeeding.

I was also part of a community crèche project which aimed to identify and treat malnourished children. We were responsible for recording the weights, heights and mid-upper-arm circumferences of children, and plotting this data on growth charts to identify those who required intervention. I found this fulfilling as I knew that I was playing an active role in improving children's health – and I'm looking forward to my career as a registered dietitian and continuing to make a difference.

I am very proud to have received the Community Nutrition Award and thank *Sight and Life* for their support of dietetics in South Africa.

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Growing the evidence base for micronutrients.

Sight and Life is a humanitarian nutrition think tank of DSM

DSM

What's new

01 WHO Launches Global Database on the Implementation of Nutrition Action

In November 2012, the World Health Organization (WHO) Department of Nutrition launched an exciting new database – known as the Global Database on the Implementation of Nutrition Action, or GINA – that provides an interactive platform for sharing standardized information on nutrition policies and action. It includes a record of commitments that have been made, and outlines who is doing what, where, when, why and how – including lessons learnt.

The database will undoubtedly be valuable to nutrition communities in many countries as it links information on policies and action to data on country-specific nutrition situations, and provides important data for monitoring purposes, encouraging accountability towards political commitments. GINA action data is available for upload by those involved in nutrition interventions such as program planners, government officials, NGO staff, research teams and other stakeholders, through a wiki approach.

For detailed information, please visit:
www.who.int/nutrition/gina/en/

02 WHO Publication: Supplementary Foods for the Management of Moderate Acute Malnutrition in Infants and Children 6 – 59 Months of Age

The WHO has recently published an excellent and much-needed report that summarizes available evidence and presents principles underlying the dietary management of children with moderate acute malnutrition (MAM). This report is timely, as taking nutrition interventions to scale is currently being encouraged and explored.

The report's "technical note" acknowledges that dietary management of MAM in children should ideally be based on the optimal use of locally available nutrient-dense foods, but recognizes that in situations of food shortage, or where some nutrients are not sufficiently available through local foods, specially formulated supplementary foods are usually required to enhance the regular diet. It also includes a proposed nutrient composition profile for such supplementary foods. Although the WHO recognizes the need for more research

on the composition, acceptability and use of supplementary foods for the management of MAM to further validate the efficacy and effectiveness of the proposed composition, the document is easy to read, clear and concise.

While it provides valuable information for senior technical and program staff in organizations involved in operational research and in the design and implementation of food-based interventions to manage MAM in children, it is not intended for field staff or community-based health workers involved in the management of malnutrition. *Sight and Life* believes this guidance will be valuable in ensuring that specially formulated supplementary foods conform to set principles and proposed nutrient composition that is grounded in the current available evidence.

A PDF file of the publication can be downloaded at: *apps.who.int/iris/bitstream/10665/75836/1/9789241504423_eng.pdf*

03 The Forgotten Vitamin: Vitamin D Status Map Launched

Vitamin D Status Map

With so much global focus on vitamin A, iron and zinc deficiency, we don't often hear about vitamin D. Yet, a recently launched Vitamin D Status Map shows that there is cause for concern in some countries and regions.

> "A recently launched Vitamin D Status Map shows that there is cause for concern in some countries and regions."

The International Osteoporosis Foundation undertook this initiative of describing the vitamin D status of the general population in different countries based on a systematic review conducted by the Mannheim Institute of Public Health in Germany, presenting this data on a world map. The aims of the study were to: provide a general overview of vitamin D status in countries for which data were available; examine the existing heterogeneities in vitamin D status; and identify research gaps. Studies focusing exclusively on the institutionalized elderly, newborn babies and those within an age range that largely overlapped the two age categories used (1–18 years and >18 years) were excluded. The final analysis incorporated the results of 200 studies from 46 countries, with the largest number of studies from Europe (48%), North America (27%) and the Asia-Pacific region (16.5%).

Researchers found large gaps in information on vitamin D status levels in certain groups, predominantly children and adolescents, and in certain regions of the world – predominantly Africa, Central America and South America. The map also shows that there is reason for concern regarding vitamin D levels worldwide, and the authors conclude that in view of the importance of vitamin D to overall musculoskeletal health and of its potential importance in other tissues, new research to define vitamin D status should be encouraged worldwide. The map and study were published in the Archives of Osteoporosis, 2012.

The Vitamin D Status Map can be viewed at the following link: www.iofbonehealth.org/facts-and-statistics/vitamin-d-studies-map

For fact sheets on all vitamins and more information on vitamins and their role in human health, please visit: *www.vitaminsinmotion.com*

Staying In Touch: Introducing *Sight and Life* Website Nutrition News

In the world of nutrition, where there is a great deal happening at all levels – policy, science and program – it can be difficult to stay on top of all the latest news and developments. We are proud to announce that *Sight and Life's* website **www.sightandlife.org** now regularly updates its News section (accessible from the home page) with the latest news on recent and upcoming events and other relevant information that we feel is important to share with our audience. We also have an active presence on Twitter @SightandLife and on Facebook, and look forward to greater interaction with you. Feel free to drop us an email at **info@sightandlife.org** and share your news, views and success stories.

04 Wrapping up the 100 Years of Vitamins Celebrations

Jeffrey Blumberg: "The next 100 years of vitamin science will likely be critical to changing our nutrition paradigm."

2012 was an exciting year for *Sight and Life* as we celebrated 100 Years of Vitamins. Vitamins form the foundation of our commitment to fighting the micronutrient deficiencies that affect the world's poor. The theme for the year was celebrating the progress that has been made since Polish scientist Casmir Funk named the vitamin, and looking forward to the promise vitamins still offer the world today.

The launch took place at the World Economic Forum in Davos where *Sight and Life* also presented its first Nutrition Leadership Award to the Scaling-Up Nutrition (SUN) Movement. The momentum continued throughout the year with events taking place from China to the United Nations General Assembly in New York. Numerous blogs and social media outlets carried our message to new audiences, and great interest was also shown by the consumer media. The website **100yearsofvitamins.com** was the central point for information on the campaign, and contains useful resources on vitamins and their role in human health.

Celebrations concluded with an event organized by the Swiss and Austrian Nutrition Societies at the University of Basel, Switzerland. The program consisted of a variety of sessions and lectures by highly respected speakers, focusing on vitamins and their role in human health – past, present and future – and the opening presentation was a captivating overview of the history of vitamin research by Professor Richard D Semba of Johns Hopkins University. The delegates were drawn from across academia, organizations, and industry. A wide range of varied but important topics, including vitamin research and progress regarding genetic diversity, were on the day's agenda – from the importance of vitamins in the first 1,000 Days, to the need for more research into improving the health and wellbeing of the elderly; from the vital role of folate, to the increasing importance of vitamin D.

The closing lecture by Professor Jeffrey Blumberg from Tufts University in Boston highlighted that the next 100 years of vitamins will continue to be important, and will likely be critical to changing the nutrition paradigm from the concept

of preventing vitamin inadequacies to focusing on establishing health and achieving optimal physiological function. In 2013, we look forward to sharing with you our new campaign, "Vitamins in Motion," that will continue to advocate for the implementation of proven micronutrient interventions in developing and developed countries to improve the health and lives of their populations. We will ensure that the essential role of vitamins and minerals in advancing health and development is highlighted, and will speak out in favor of mobilizing support for scaled-up actions and to strengthen and build partnerships to ensure brighter futures for generations to come. Watch this space!

The proceedings can be viewed as a webcast on the 100 Years of Vitamins website: *www.vitaminsinmotion.com//symposium.html*

05 The Economist Feeding the World Series: Africa's Role in Solving the Food Crisis

With Africa's population growing fast, the challenge of providing nutritious food to all is immense. Global leaders from agribusiness, governments, the scientific community, donors and NGOs came together on November 15 and 16 in Johannesburg to explore the complexities of the issues surrounding food insecurity, and proposed possible solutions. *Sight and Life* was proud to be a key supporter of the event. As a supporter, *Sight and Life* set up a booth at the venue that drew a number of visitors, and also sponsored a delegate – Oyoo Abiud from the Ramala Woman's Group in Kenya – to attend.

Three themes dominated discussions at the conference: first, the need for stakeholders across the agricultural sector to collaborate in new ways; second, the need to focus on improved nutrition and not just the avoidance of hunger; and last, but not least, the fact that most African farmers are women – a reality that brings with it its own distinct set of issues. On the first evening of the event, *Sight and Life* Director Klaus Kraemer took part in a discussion that set the tone for the event, highlighting three critical points:

1. We cannot talk about food security without talking about nutrition security – the two are wholly interconnected. This is evidenced by the fact that expanded food production has done little to address malnutrition contributing to one-third of all under-five child deaths in developing countries. We now know that simply increasing crop yields and filling bellies with staple foods alone doesn't necessarily lead to improved nutrition.
2. It is critical that we break down the silos we have traditionally worked within. Nutritionists, agriculturists, public health workers, financiers and businesses need to come together to develop and implement innovative solutions and business models to reach people everywhere – rich and poor, urban and rural – with affordable, nutritious foods.
3. There is an urgent need to turn talk into action and to accept that public-private partnerships must be part of the solution. It is no longer a matter of whether or not these partnerships are required, but rather of setting rules of engagement with which to move forward to create significant and sustainable health and nutrition outcomes for people.

Definition of partnership:
"A relationship between individuals or groups that is characterized by mutual cooperation and responsibility, as for the achievement of a specified goal"

The conversation was stimulating and thought provoking, and it was encouraging to have such a diverse group of stakeholders gather together. But now, the challenge is to see if Africa can indeed address the food and nutrition security challenges it is facing.

Some of the presentations from the conference are available at: *cemea.economistconferences.com/content/feeding-world-africa-download.*

06 Women Take Center Stage at *Economist* Feeding the World 2013 Conference

Feike Sijbesma (Chief Executive Officer of DSM)

Women, farmers and food wastage were key topics at the Economist Feeding the World 2013 conference, which was held in Amsterdam on 30 January 2013.

The fully subscribed day-long event, which attracted delegates from around the world, combined keynote speeches, presentations, workshops and panel discussions in a packed and interactive program whose topics ranged from the drivers of rising obesity levels to methods of sustainable fish-farming.

Sharon Dijksma, Minister for Agriculture, Government of the Netherlands, was the first of three high-profile female keynote speakers to take the microphone. Quoting Mahatma Gandhi's observation that "Our salvation can only come through the farmer," Ms Dijksma made a passionate plea for the introduction of "climate-smart" agriculture that will "put farmers and agribusiness in the driving seat." Noting that food insecurity is rooted in poverty and that hunger eats away at people's health and even their sanity, the Minister outlined how the Dutch government is supporting farmers in Africa to make them more productive. She stressed that investment in agriculture needs to be "environmentally sustainable and developmentally fair," and that "education, research and extension are the keys to sustainable agriculture."

Her Royal Highness Princess Máxima of the Netherlands was the next to speak, drawing on her experience as UN Secretary-General's Special Advocate for Inclusive Finance for Development. Princess Máxima explained the need for the world's rural dwellers – who account for 70 per cent of the global population – to have access to the financial services that will support their endeavors. She pointed out that financial services have to be combined with technical assistance, and that the lot of smallholders could be improved by combining financial services with measures that guarantee access to markets.

Next to speak was Ellen Gustafson, Founder & Executive Director, The 30 Project, whose topic was *"Inside the Mind of the Future Consumer."* "The connection between hunger and obesity is the problem for our generation," she said. Ellen explained that numbers of famers worldwide have declined since the 1980s, while their share of the profit from their produce has likewise fallen. Noting that "The way we consume in the west is often the way that the rest of the world will consume in time," she pointed out that elitist consumption patterns in the West (e.g. consumption of kale, which contains a variety of micronutrients) might have positive spin-offs for the developing world. "We have to look into the trends of the future consumer," she concluded, "for it is that generation that will have to feed the world well."

> "Hunger – in whatever form – is one of the solvable problems in the world."

Last of the keynote speakers was Feike Sijbesma, Chief Executive Officer of DSM, who spoke about the role and responsibility of business in feeding the world. The role of business has changed in the past fifty years, Mr Sijbesma explained. Fifty years ago, there were no global companies. Today's global companies have a massive impact on the world, however. Their responsibilities therefore have to change, and they have to create value along the dimensions of People, Planet and Profit. "The billion richest people in the world make use of 45 per cent of the world's resources and create 45 per cent of the world's waste," he said, adding that: "30 per cent of all food produced today is wasted." Feike Sijbesma's address concluded on a positive note, however, insisting that "hunger – in whatever form – is "one of the solvable problems in the world."

Powerful presentations followed from Jason Halford of Liverpool University, Andrew Sharpless of Oceana, and Jason Aramburu of re:char, while afternoon workshops covered the topics *"Achieving nutrient-rich diets"*, *"Smallholders and the financial system"* and *"The enabling role of science and technology"*. The final plenary discussion was on the topic – now uppermost in the minds of all present – of "Getting tough on food waste".

For more information please visit:
cemea.economistconferences.com/event/feeding-world-2013

07 Nutrition Leaders Join Ranks Worldwide to Launch new SUN Business Network

Jay Naidoo (GAIN), David Nabarro (SUN, Scaling up Nutrition)

Representatives of business, government, non-governmental organizations and civil society gathered in London on 11 December 2012 to launch the Scaling Up Nutrition (SUN) Business Network. Sponsored by the United Nations World Food Programme (WFP) and the Global Alliance for Improved Nutrition (GAIN), this landmark event attracted high-profile speakers from every dimension of the nutrition space and generated energetic debate in a number of chaired panel discussions and facilitated workshop sessions.

Malnutrition is the root cause of 2.6 million child deaths globally every year. In addition, one in four children are stunted, which means their bodies and brains have not been able to develop fully due to malnutrition. The SUN Movement is a collective, global effort to eliminate malnutrition in all its forms. The SUN Business Network provides the platform that allows businesses around the world to demonstrate their commitment to improved nutrition, to work with the SUN Movement, and to align behind national policies.

Like other stakeholders in the SUN Movement, businesses support governments in the pursuit of national policies, work within national legal frameworks and engage fully with other stakeholders (including civil society) at country level in line with the SUN Movement's Principles of Engagement. The launch event in London aimed to expand the reach of the SUN Movement through a more systematic involvement of a range of businesses around the world – from small, local entrepreneurs to major multinational companies. This initiative is supported by the launch of a new online global forum designed to help business share knowledge and best practices on sustainable models designed to improve nutrition worldwide.

"Businesses are called upon to help deliver solutions to the people who need them most"

Marc Van Ameringen (GAIN)

"As momentum increases in the fight against malnutrition on the global development agenda, businesses are called upon more and more to help deliver sustainable, affordable and nutritious solutions to the people who need them most," said Marc Van Ameringen, Executive Director, GAIN. "The SUN Business Network will provide business leaders with greater opportunities to engage both with peers and with cross-sector stakeholders to drive greater collective impact."

"If we are serious about improving nutrition for vulnerable communities, we will have to work in partnership with the private sector," added WFP's Senior Nutrition Advisor, Martin Bloem. "WFP can give people the assistance they require to access the food they need, but we are looking to the private sector to help develop and implement national plans on nutrition, and to ensure that the right kinds of food products are available to meet nutritional needs."

David Nabarro, Special Representative of the UN Secretary General for Food Security and Nutrition and Coordinator of the SUN Movement, underlined the importance of the contribution that business can make. "Business has a vital role to play," he observed. "Simple solutions exist and we know they work. Investments in good nutrition, especially during the 1,000 days of a mother's pregnancy until her child's second birthday, will sow the seed that allows a child to achieve his or her full potential. I believe that the Network can find ways to harness business expertise and apply its strengths to support countries' efforts to improve nutrition. I encourage all types of business representatives to join the Network."

About the SUN Movement

One third of the world's children do not grow to reach their full potential because of poor nutrition. Good nutrition, especially in early childhood, is an essential requirement for each world citizen to earn, learn, stay healthy and achieve his or her lifetime potential.

The SUN Movement was launched to support national leadership and collective action to scale up nutrition. SUN is not a new initiative, institution or fund; instead, it is a country-led Movement with hundreds of organizations and entities working to increase the effectiveness of existing programs by supporting national priorities, aligning resources and fostering broad ownership and commitment to nutrition.

Anchored by country leadership, SUN represents an unprecedented collective global commitment to create sustainable and systemic change to improve nutrition. The SUN Movement is focused on implementing evidence-based nutrition interventions and integrating nutrition goals across sectors – including health, social protection, poverty alleviation, national development and agriculture.

SUN supports a dual approach, recognizing the important role nutrition plays in improving maternal and child health in the short-term, as well as building the foundation for a healthy, more prosperous future and resilience in times of crisis.

The SUN Gets Stronger

There is no doubt that the Scaling Up Nutrition (SUN) Movement is one of the greatest "happenings" in nutrition in the last decade and that it is growing in strength and momentum:

- Thirty-three countries, home to 59 million stunted children, have now joined the SUN Movement and are committed to demonstrating results in improved nutrition.
- Twenty-eight have established platforms that bring people together and are convened by the government.
- Twenty have updated and budgeted nutrition plans that have been endorsed through relevant legislative processes.
- Eleven are scaling up nutrition rapidly and another 9 are ready to scale up.
- Eleven are reducing stunting by over 2% annually.

"I believe that if we all play our part, we can bring about a sustainable future that eliminates hunger and malnutrition." *Paul Polman, CEO of Unilever and SUN Lead Group Member*

In December, the SUN Business Network, convened by the Global Alliance for Improved Nutrition, (GAIN) and the World Food Programme (WFP), was launched in London. The SUN Business Network aims to improve collaboration between business and other stakeholders, and to find ways to harness

business expertise to stimulate the role of the private sector in making nutritious foods more accessible and affordable to the poor. Paul Polman, CEO of Unilever and SUN Lead Group Member, expressed his optimism, saying, "I believe that if we all play our part, we can bring about a sustainable future that eliminates hunger and malnutrition."

To read the latest SUN country progress report, please visit:
scalingupnutrition.org/wp-content/uploads/2013/01/SUN-Progress-January-2013-22_1-v3.pdf

08 Public-Private Partnership Brings a Value of $15 Million to Africa

In November 2012, Partners in Food Solutions, a consortium of General Mills, Cargill and DSM, announced that they had signed an agreement with the United States Agency for International Development (USAID) enabling them to expand the reach of the technical and business expertise they provide to small and growing food processors in sub-Saharan Africa in order to improve food security. The partnership is an example of how sharing expertise can provide benefits, and the agreement will see employee volunteers share 50,000 hours of technical and business expertise with food processors and millers throughout Eastern and Southern Africa with the aim of strengthening this sector of the food industry. Partners in Food Solutions plans to broaden this work over the next five years to include 10 corporate partners, working with 500 Africa-based food processors that purchase from more than 500,000 smallholder farmers in 12 African nations. This is exciting news, and a further commitment to exploring potentially winning partnerships. *Sight and Life* will continue to follow their activities with interest.

For more information, please visit:
www.partnersinfoodsolutions.com

09 Indonesian Social Enterprise Project Gets Bigger And Better

KeBAL, the healthy street food social enterprise aimed at providing nutritious meals to Jakarta's children in poor urban localities, will soon be expanding across more of the city's neighborhoods. This expansion is a result of a partnership between KeBAL, the Mercy Corps' Indonesian food cart social enterprise, the Robobank Foundation and DSM's Nutrition Improvement Program (NIP).

The aim is to help grow KeBAL and transform it into a viable and attractive franchise concept that offers both affordable and nutritious meals to Indonesia's youngest and often most nutritionally-deprived children. The proposition of "street food, children and nutrition" is unique. Highlighting what the partnership is about, Mercy Corps CEO, Neal Keny-Guyer said, "This collaborative effort on behalf of Mercy Corps and DSM is the perfect marriage of innovation and scalability." Innovation, thinking out of the box, and new partnerships are without a doubt the way forward in solving many of the nutrition challenges we continue to face.

> "This collaborative effort on behalf of Mercy Corps and DSM is the perfect marriage of innovation and scalability."
> *Neal Keny-Guyer, Mercy Corps CEO*

10 Global Week of Action in Support of Actions Not Words to Improve Child Health

Under the banner of their "Child Health Now" campaign, World Vision International encouraged the world to show their leaders that they want action, not words, to save children's lives, during a Global Week of Action in November 2012. The "Child Health Now" campaign aims to enable those individual and groups most affected by the scourge of child deaths to take action and demand change.

> "Alone we can do so little; together we can do so much."
> *Helen Keller*

The response to this campaign was overwhelming, with more than two million people in over 80 countries taking over 2.6 million actions to show leaders that they want all children to survive their fifth birthday. Some 935 public events, ranging from concerts and community meetings to policy dialogues, were organized and attended by 1.8 million people. In addition, a wide variety of influential figures supported the campaign including leaders, actors, musicians, CEOs and sportsmen, and approximately 20 organizations including *Sight and Life* officially partnered with the Global Week of Action. While critics might say that such campaigns are in themselves words without real action, they do in fact highlight the need for the nutrition community to ensure that nutrition remains high on the global agenda by constantly reminding the world of its critical role – that we must speak up and speak out, for, as Helen Keller said, "Alone we can do so little; together we can do so much."

The extended global *Sight and Life* team gives hands up for the Child Health Now campaign

A Food Composition Table for Central and Eastern Uganda

HarvestPlus has recently made available a compilation of existing and imputed food composition data for foods commonly consumed in Central and Eastern Uganda. Food items included in the table were derived from two dietary intake surveys conducted in 84 selected communities from three districts in the Central and Eastern regions of Uganda among women and children from 6–7 years of age. The foods included are broadly representative of those consumed in these regions. Two other valuable tables are included in the publication – the first, a table of gram-weight conversion factors to aid in the quantification of portion sizes of foods consumed, and the second, a set of standard recipes for commonly consumed composite dishes in the region.

The full document or electronic files can downloaded at:
www.harvestplus.org/content/food-composition-table-central-and-eastern-uganda

Vigilance is Vital for Continued Success

According to the latest International Council for Control of Iodine Deficiency Disorders (ICCIDD) Newsletter (November 2012), in 1993, 110 countries were classified as "iodine-deficient," but by 2012 that figure was down to 32 thanks to salt iodization. However, the ICCIDD highlights that on-going vigilance is critical to ensuring that the advances made in the elimination of iodine deficiency disorders (IDD) are not lost. Vietnam is cited as an example of a country that, due to lack of continued funding of iodization initiatives, price increases, reversal of mandatory fortification and disinvestment in vital information, education and communication, is experiencing a resurgence in IDD.

To subscribe to the quarterly ICCIDD Newsletter, please visit: *www.iccidd.org*

11 Rainer Gross Prize 2012 Awarded to Two Zinc Specialists

Daniel Lopez de Romaña on behalf of Kenneth H Brown and Manuel Ruz together with Klaus Schuemann, CEO of the Hildegard Grunow Foundation, after the Award ceremony.

Created by the Hildegard Grunow Foundation in Munich, Germany, the Rainer Gross Prize recognizes recent innovations that stand to improve nutrition in developing countries. Endowed with $2,500 (US), the prize is awarded on a biennial basis and named for Dr Rainer Gross, who headed the UNICEF Department of Nutrition until his untimely death in 2006. Dr Gross was devoted to investigating the impact of micronutrients on health, including physical and mental development in children. Moreover, he introduced several innovations to improve the micronutrient supply in Brazil, Indonesia and Peru.

The Rainer Gross Prize was presented to Kenneth H Brown of the University of California, Davis, and Manuel Ruz of the Universidad de Chile, on November 14, 2012 during the XVI Congress of the Latin American Society of Nutrition (SLAN) in Havana, Cuba. Both recipients have focused their research efforts on the preventive and therapeutic use of zinc in vulnerable populations from developing and transitional countries.

A pediatrician, Professor Kenneth Brown is widely recognized for his rigorous, creative research in clinical nutrition and nutritional epidemiology, focusing on the problems of low-income children, including dietary management of diarrhea, feeding strategies, treatment of acute malnutrition, and control of micronutrient deficiencies, particularly zinc and vitamin A. Professor Brown has endeavored to ensure that his research is applied appropriately in public health programs and has worked in Thailand, Bangladesh, Peru and Senegal as well as serving as a consultant to international agencies including WHO and UNICEF.

Professor Manuel Ruz works in human nutrition. After several years of research in Guatemala and the completion of his doctoral studies in Canada, he is now Chair of the Nutrition Department at the Faculty of Medicine in Universidad de Chile. His research focuses on the nutritional and toxicological aspects of minerals and trace elements, particularly on the diagnosis, prevention and treatment of mineral deficiencies in both at-risk populations and clinical settings. He has also served as a consultant to the WHO and UNICEF, and is involved in the development of national and international nutrition programs.

For more information, please visit:
www.hgrunowfoundation.org

12

Codex Alimentarius JECFA Confirms the Safety of Phytase

The Annual Meeting of the Joint FAO/WHO Expert Committee on Food Additives (JECFA) evaluated certain additives, including 3-phytase (from *Aspergillus niger*) for which new specifications have been listed. The report states that, on comparing the conservative exposure estimate with the no-observed-adverse-effect level (NOAEL) from a 13-week study of oral toxicity in rats, the margin of exposure is approximately 250.

The Committee allocated an ADI (Acceptable Daily Intake) "not specified" (see box) for the 3-phytase enzyme preparation derived from *A. niger* and expressed in *A. niger*, used in the applications specified and in accordance with good manufacturing practice.

This is certainly good news, as phytase added to micronutrient powders (MNPs) or other products (e.g., phytate-rich ready-to-use complementary foods [RUCFs] – or the use of phytase during food processing – can help reduce mineral deficiencies and related adverse health outcomes. It does this by improving mineral bioavailability, even with low doses of iron and/or zinc. This growing interest in the use of enzymes to break down anti-nutritional substances in staple foods could result in new solutions, which might offer significant benefits in terms of eliminating micronutrient deficiencies.

What does ADI "not specified" mean?

ADI "not specified" is used to refer to a food substance of very low toxicity that, on the basis of available data (chemical, biochemical, toxicological and other) and total dietary exposure to the substance arising from its use at necessary levels, does not, in the opinion of JECFA, represent a hazard to health. For this reason, the establishment of an ADI expressed in numerical form is not deemed necessary. This criterion must be used in conjunction with good manufacturing practice (i.e., the substance should be technologically effective and should be used at the lowest level necessary to achieve this effect; it should not conceal food of inferior quality or adulterated food; and it should not create a nutritional imbalance.)

13

Alfred Sommer Named Dan David Laureate

Alfred Sommer: Recognized for his groundbreaking research into vitamin A

Alfred Sommer, MD, MHS, University Distinguished Service Professor of Ophthalmology, in the School of Medicine, and Epidemiology and International Health and dean emeritus of the Johns Hopkins Bloomberg School of Public Health, has been named a Dan David Laureate for his groundbreaking research into vitamin A. Sommer's studies determined that vitamin A supplementation could save millions of children's eyesight and lives, and is considered among the most cost-effective health interventions in the world.

The Dan David Prize, an internationally distinguished award, is named after businessman and philanthropist Dan David and is administered by Tel Aviv University. It recognizes outstanding achievement in chosen, rotating fields, judged important to the "past," "present," or "future". Sommer is being honored in the "future" category, which this year recognizes achievement in preventive medicine. Sommer will share the $1 million prize with economist Esther Duflo of the Massachusetts Institute of Technology, whose work on social conditions and strategies related to the alleviation of poverty deals directly with prevention of disease. As is tradition, Dan David Prize recipients donate 10 percent of their prize money to graduate students in their respective fields.

Trained in ophthalmology and epidemiology, Sommer proved that vitamin A deficiency dramatically increased childhood morbidity and mortality from infectious disease. He further demonstrated that a 4-cent dose of vitamin A not only prevented and cured eye disease, but also reduced childhood deaths by 34 percent. Because of his work, the World Health Organization, UNICEF and their partners now annually provide more than half a billion high-dose vitamin A supplements to children around the world, saving literally hundreds of thousands of lives each year.

"Al Sommer is one of the true giants of public health. His discoveries have saved millions of children worldwide," said Michael J. Klag, MD, MPH, Dean of the Bloomberg School of Public Health. "The Dan David Prize is a tremendous honor for Al and for the entire Bloomberg School community."

Also named Dan David laureates this year are Sir Geoffrey Lloyd of the Needham Research Institute and the University of Cambridge, Michel Serres of Stanford University and Université de Paris, and Leon Wieseltier, noted American intellectual, philosopher and literary editor of *The New Republic*. Previous laureates include former U.S. Vice President Al Gore, former British Prime Minister Tony Blair, cellist Yo-Yo Ma, filmmakers Joel and Ethan Coen, and last year's scientists, David Botstein, Craig Venter, and Eric Lander.

The Dan David laureates will receive their awards at a ceremony held at Tel Aviv University on June 9, 2013.

Reprinted from *www.jhsph.edu/news/news-releases*

14 India's Call to Action Summit on Child Survival and Development

In February, a three-day summit was organized in India by the Ministry of Health and Family Welfare in partnership with UNICEF and USAID, to address the critical issue of child survival. The summit was attended by over 60 national and international experts and 300 delegates including national and state level policymakers and program managers, private and public sector leaders, researchers, community mobilizers, and media and development partners. The summit culminated in a call to further reduce the under-five mortality rate in India, and produced a set of agreed-upon actions that will sustain momentum and promote accountability for India's journey towards achieving the Millennium Development Goals (MDGs) related to maternal and child mortality.

Some of the core themes discussed during the three-day summit included: improving accountability and transparency through a National Child Survival Score Card – an innovative dashboard for tracking progress; the supportive supervision model; child health screening and early intervention processes; newborn health and the continuum of care; MDGs and beyond; prevention of diarrhea and pneumonia; social determinants of child survival; the role of communication in child survival; and partnership and leadership dialogue. In addition, a number of strategy documents and operational guidelines were released by the Ministry of Health and Family Welfare during the summit.

In his opening address, Union Minister for Health and Family Welfare Shri Ghulam Nabi Azad announced an incentive program for states performing well in newborn and under-five children's health and development initiatives, but equally importantly, he also cautioned that underperforming states would be dis-incentivized. In a video message to summit participants, USAID Administrator Dr Rajiv Shah said, "This is an extraordinary step, and it represents exactly the kind of innovative, results-oriented, and country-led approach we need in order to achieve incredible results together."

An excellent blog post discussing the summit on the Impatient Optimists website (run by the Bill and Melinda Gates Foundation) concludes that: "in order to move forward and meet the ambitious road map that has been set, India will need the support of its champions in the private sector, in academia and among its local leadership. The need for leadership is reiterated, and as we head towards the 2015 MDG deadline and look beyond, it is strong country leadership that will determine if nutrition can succeed in delivering on its promises of being a cornerstone of development, improved life expectancy and quality of life."

To access the Impatient Optimists blog post on India's Call to Action Summit on Child Survival and Development, please visit: *www.impatientoptimists.org/Posts/2013/02/Indias-Call-to-Action-Summit-for-Child-Survival*

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DSM

dear... Letters to the editor

Correspondence from Pakistan: **Continuing the Discussion on Adequate Nutrient Intakes for Infancy**

Zulfiqar Ahmed Bhutta
The Noodin Noormahomed Sheriff Endowed Professor and Founding Chair, Aga Khan University, Karachi, Pakistan

This letter is a response to David Thurnham's article on "Adequate Nutrient Intakes for Infancy, Part 1: From 0 to 6 Months," published in *Sight and Life* Magazine, Vol. 26 (3) 2012 [Ed.]

The article by Thurnham et al[1] in *Sight and Life* 3|2012 reviews the evidence around breast milk volumes, nutrient composition and recommendations for infants under six months of age. The review covers a vast landscape and summarizes pertinent information as to volume, energy and micronutrient needs, and adequacy of intake through breastfeeding and breast milk. In addition to useful information on milk volumes and energy, an important conclusion made by the authors is the identification of Group 2 nutrients whose concentrations are unaffected by maternal intake, and can lead to maternal depletion. This is a key step in addressing the adequacy of intake in the first six months of life.

The review highlights two areas that merit further work. Firstly, there exists a real need to develop sensitive and reliable methods for estimating breast milk intake in a range of settings. The continued reliance on test-weighing and the variability in measurements in ambulatory settings makes this a less-than-optimal method for assessing breast milk volume. Although there are established stable isotope techniques for measuring breast milk intake[2,3] these are onerous and not widely available. Secondly, information on breast milk intake and quality in malnourished populations is also outdated, and few studies have been conducted in populations with high rates of HIV infection or among wasted women with a body mass index < 18.5 kg/m^2. While studies do suggest that the volume of breast milk produced may not be affected during acute infection, milk composition is known to change during this state.[4] Although the effects of marginal maternal malnutrition on breast milk composition and quality are well-recognized,[5] these effects may be exaggerated among populations with more severe forms of maternal wasting and concomitant infections such as HIV.

> "Investments must be made in optimizing the health and nutrition of mothers"

As underscored by Thurnham,[1] the onset of linear growth failure among young infants varies in different populations. While the onset of stunting may accompany the introduction of complementary foods after 4–6 months, and coincidental infections,[6] in many regions the onset of linear growth retardation may occur earlier[7] and reflect the impact of maternal health factors and micronutrient deficiencies. The implications of these findings and the limitations of addressing key micronutrient deficiencies sufficiently through maternal supplementation during lactation suggest the need for intervening early during pregnancy, or the pre-pregnancy period. In many populations with high rates of maternal micronutrient deficiencies and malnutrition, most women present for antenatal care well into the second trimester, and replenishing deficits in this limited time window of pregnancy may not be possible.[8] In such circumstances, reaching adolescent girls and women in the pre-pregnancy period, along with adequate birth-preparedness and nutrition support, is critical in addressing key micronutrient deficits during pregnancy and early infancy. With the increased emphasis on lactation support and counseling for breastfeeding, comparable investments must be made in optimizing the health and nutrition of mothers prior to, and during, pregnancy.

There is a need to develop sensitive and reliable methods for estimating breast milk intake. At the same time, information on breast milk intake and quality in malnourished populations is also outdated, in the view of *Zulfiqar Ahmed Bhutta*.

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BOOKS

Reviews & Notices

Editor's note: This section contains reviews of books, publications and websites which, 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.**

Publication Review

Large-Scale Food Fortification: Optimizing Program Implementation – Country Experiences and Technical Considerations

Food and Nutrition Bulletin, Volume 33, Supplement 3, December 2012

Guest Editors: Regina Moench-Pfanner, Arnaud Laillou, and Jacques Berger

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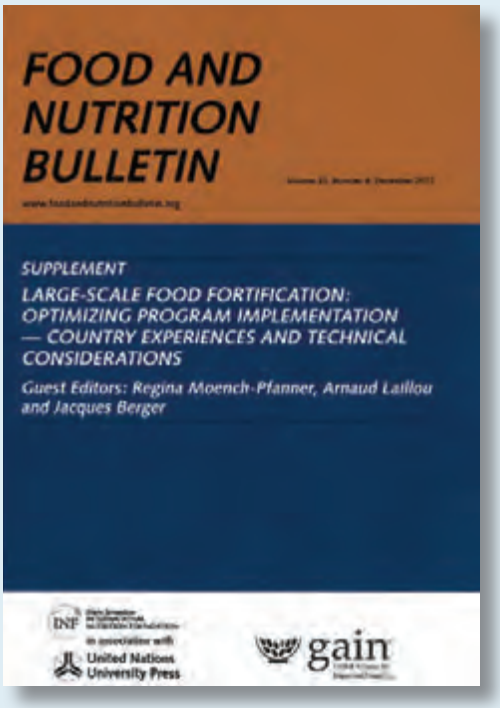
Established in 1978, the Food and Nutrition Bulletin (FNB) is a peer-reviewed journal published quarterly by the Nevin Scrimshaw International Nutrition Foundation (INF) in association with the United Nations University. The FNB supplement reviewed here was produced as part of the Global Alliance for Improved Nutrition's (GAIN) lessons learned agenda with support from the Bill & Melinda Gates Foundation and the United Kingdom Department for International Development.

"GAIN launched its first large-scale fortification program in 2003, and in under a decade was reaching more than 600 million people with nutritionally enhanced food"

GAIN was established in 2002 to galvanize efforts by the public and private sectors to end malnutrition. GAIN launched its first large-scale fortification program in 2003, and in under a decade was reaching more than 600 million people with nutritionally enhanced food. It has since expanded into new areas, and continues to respond to a changing nutrition landscape by introducing new programs and novel partnerships, and by refining delivery models.



Focusing on lessons learned

This supplement focuses on successes and lessons learned on large-scale food fortification, where essential nutrients (such as vitamin A, iron, iodine and folic acid) are added to staple foods and condiments so that people and economies can thrive to their full potential. Micronutrient fortification has been acknowledged as one of the best, most cost-effective development returns on investment. GAIN aims to strengthen ongoing and new large-scale food fortification programs globally, complementing and strengthening other nutrition interventions targeting women and children.

> "While a broad range of interventions has been implemented, many more people could still benefit from fortification programs"

While a broad range of interventions has been implemented to tackle malnutrition, many more people could still benefit from fortification programs. The articles of this supplement highlight successes in four areas: building platforms such as public-private partnerships and models; increasing access to fortified foods; improving quality assurance and control; and new innovations and trends.

GAIN's experience shows that strong top-level political commitment is key. Under Egypt's national Food Subsidy Program, for example, fortificants are added to wheat flour. In Ghana, large-scale food fortification has been successfully integrated within national programs to address micronutrient deficiencies. However, it is easier to start fortification in countries with large, centralized food industries such as milling, and countries that supply subsidized or free grains have good channels for reaching those most in need. Experience shows that national fortification programs take several years to develop and that challenges to implementation can be addressed through new technologies and programming models.

A good example is a new device that measures the content of potassium iodate in salt simply, safely, and quickly. Fortification projects in Morocco, Uzbekistan, and Vietnam, meanwhile, benefitted from the development of fortification standards and the procurement of equipment. The quality of fortified foods and shifts in consumption patterns and market structures were challenges that GAIN is incorporating into its future programming.

Successful experience from developed countries can also be adapted to developing nations. In Bangladesh and Pakistan, widely available bread, biscuits, and snacks containing salt provide an opportunity to increase iodine intake. The findings of a pilot study, meanwhile, could encourage Indonesia to fortify more edible oils for export, allowing for market expansion and potential leadership in reducing vitamin A deficiency. Strong alliances at regional and national levels are crucial for sustainability and scale-up; in the West African Economic and Monetary Union, a public-private partnership that coordinates standards, regulations, and social marketing has led to sustainable vitamin A fortification of cooking oil becoming a reality in all the Union's countries.

It is clear that constant innovation is needed, and that population needs, costs and potential beneficial synergistic reactions must all be taken into consideration when carrying out large-scale fortification. There is undoubtedly much ground ahead to cover, but the articles contained in this supplement provide a clear and comprehensive picture of the progress that has already been made in the field, and provide important lessons for how to move forward.

These are just some of the highlights from the bulletin. We hope you enjoy reading it!

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