The National Family Health Survey (NFHS-3) in India

The first National Family Health Survey (NFHS-1) was launched in 1992–93 to collect comprehensive and nationally representative data on the health and nutrition situation of India. NFHS-2 was conducted in all 26 states of India in 1998–99, collecting additional information on the quality of health and family planning services, reproductive health, and anemia rates in women of reproductive age (15–49 years) and children under three years of age. Read more on p15
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Welcome
A Vision of a Common Agenda

Early childhood stunting (lack in linear growth), anemia and obesity are the most significant nutritional problems in the world; they are associated with increased morbidity and mortality, deficits in cognition, poor motor and social development, school failure, and last, but not least, economic loss. About one third of all children under 5 years of age worldwide are stunted and almost 50% are anemic, while at least 155 million school-age children are overweight or obese.

The emerging epidemic of obesity and non-communicable diseases is no longer a problem restricted to industrialized countries. In most developing regions, there is concurrent underweight and stunting in very young children as well as overweight in older children and adults. A recent report from rural Mexico further raises the concern over the simultaneous risk of overweight and stunting in pre-school children. In the affluent USA – despite flour fortification with iron and B-vitamins – iron deficiency affects 2.4 million children and is more prevalent among overweight children of low socioeconomic status.

There is a common theme in these and many other studies: The poor fare worse in terms of nutrition and health outcomes and are less likely to benefit from effective interventions. Living in poverty increases the risk of early childhood stunting and micronutrient deficiency and later-life overweight and obesity. In developed countries (and among the middle class of developing countries), obesity begins in childhood and adolescence, predisposing populations intrinsically vulnerable to death from malnutrition at a young age to the additional risk of premature death from non-communicable diseases at older ages.

There is no escape from the poverty-education-nutrition-health trap without a common agenda. The implications of malnutrition in all its forms should be clearly understood not only by experts, but also by key stakeholders, policy makers, politicians and the public at large. With an integrated evidence-based strategy for public health interventions at all stages of the lifecycle, substantial improvement is possible. Providing for good nutrition early in life is an important first step in preventing adult nutrition-related chronic disease. In particular, strategies to improve the availability of high-quality (micronutrient-rich) and low cost complementary foods appear crucial to reducing stunting among infants and young children, with the potential to increase economic productivity in adulthood. Recent evidence also suggests that formal maternal and paternal education are strong determinants of child stunting, which offers increased opportunities for integrating nutrition and health with strategies to increase access to formal education for underserved populations.

Strategies that are aimed at promoting healthy diets and lifestyles should integrate all sectors of society, including the agriculture and food industry, and transport and leisure sectors, not just the health sector. They require intersectoral dialogue and action, and may affect the prosperity of several sectors that contribute to economy. The relative costs of both the consequences of the emerging health problems and the preventive solutions available need to be highlighted to offer an incentive for developing societies and the world at large to achieve sustained successes in tackling the rising burden of malnutrition.

Combating this double burden of global malnutrition is a challenge that needs to gain momentum, and needs to be addressed together by all stakeholders, and not only the food and nutrition community, in both developed and developing societies.

This first issue of SIGHT AND LIFE Magazine in 2008 features a report (p6) on a study in Bangladesh that found folic acid supplementation lowers blood arsenic concentrations among folate-deficient adults. The significance of this finding can be better appreciated with the understanding that chronic arsenic exposure is a major health concern in 70 countries and increases the risk for various cancers, and for heart and vascular diseases.

On p15, we carry an update on the findings from the National Family Health Survey-3, carried out in India in 2005-6, which show that, despite the declining infant and underfive mortality rates in India, undernutrition and micronutrient deficiencies continue to remain at unac-
ceptably high levels. Furthermore, in urban India, under-nutrition and overweight or obesity appear to have reached equal proportions of the population, suggesting the double burden of under- and over-nutrition will continue to grow.

Two reports in this issue describe the problem of vitamin A deficiency: On p22, we have a report on a study from India that documents VAD as a continuing public health problem among pregnant women in rural areas of the Udham Singh Nagar district, with large numbers of pregnant women suffering from night blindness. On p25, we have an extensive review on the problem of vitamin A deficiency in Ethiopia, examining the distribution of vitamin A deficiency during the last 50 years and the impact of major intervention measures.

On p34, we have a summary on a conference organized by the NIH on the topic “Vitamin D and Health in the 21st Century: An Update” in September 2007 in Bethesda, Maryland. Among the conference’s objectives were to evaluate the available evidence on the efficacy and safety of vitamin D, and identify gaps in knowledge on its efficacy and safety in general and across the life cycle.

In our Day in the Life section on p40, we feature Venkatesh Mannar, president of The Micronutrient Initiative (MI), a not-for-profit organization supporting some of the most vulnerable people in the world by ensuring that they receive adequate supplies of the micronutrients they need for a healthy diet.

We decided to change the Recent Literature section completely. For the foreseeable future, recent literature will be abstracted and uploaded onto the SIGHT AND LIFE website, www.sightandlife.org. Furthermore, shifting the abstracts to our website allows all recent papers to be included and prevent a backlog developing. And last but not least, there is something to be said for shifting information from offline (trees) to online media (energy that can be used more efficiently or sourced renewably) in light of important environmental concerns.

The Literature Digest (p43) continues to be a staple in SIGHT AND LIFE, but from this issue on, this will be presented as one or more short reviews on current topics of interest in the micronutrient field – in this issue, the topic is vitamin D and some recent concerns about its supply. Vitamin D is conventionally associated with calcium metabolism and the development of healthy bones. Several years ago, however, vitamin D receptors were found to be present on cells from many other tissues than bone, including immune cells. If vitamin D has a role in immunity or the prevention of cancer, this is particularly important as poor vitamin D status is present in both the developed and developing world, in segments of the population who have inadequate exposure to sunlight.

We hope you continue to quench your thirst for knowledge and information on all things related to micronutrients and health in our pages as we continue to perfect our presentation through the Magazine and the brave, new medium of the World Wide Web!

Best regards,

The scope of the crisis

Chronic arsenic exposure is a major health concern in 70 countries, and currently affects more than 100 million people worldwide. Several regions scattered throughout South and East Asia as well as the Americas have naturally occurring arsenic in groundwater. Roughly 42 million Americans obtain their drinking water from household wells, and in many parts of the country, notably the Northeast, Southwest and upper Midwest, naturally occurring arsenic is prevalent in drinking water. In the USA, arsenic consumption from well water has been strongly linked to increased risk for bladder cancer.

In Asia, at least 60 million people are at risk of chronic arsenic exposure, of whom roughly 35 million reside in Bangladesh. Data collected from over 6,000 wells in our study site, Araihazar, Bangladesh, as part of the Columbia University Superfund Basic Research Program (CU-SBRP) have determined that well-water arsenic concentrations range from <5 to 960 µg/L, many far in excess of the maximum contaminant level of 10 µg/L established by the WHO and the Bangladesh standard of 50 µg/L.

The tragic situation is underscored by the fact that, as part of a milestone effort to reduce infant mortality associated with diarrheal disease in the 1960s, several non-governmental organizations encouraged a massive shift from drinking microbially-contaminated surface water to groundwater accessed by tube wells. Twenty years later, it was discovered that roughly half of these wells contain high concentrations of arsenic.

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The Role of Folate in Mediating the Metabolism and Toxicity of Arsenic

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This research was supported by grants RO1 ES011601, P42 ES10349 and P30 ES009089 from the National Institute of Environmental Health Sciences.

Figure 1: Arsenic exposure in Bangladesh.
Arsenic is the most common source of heavy metal/metalloid poisoning. Individuals chronically exposed to arsenic have increased risk for various cancers, including cancers of the skin, lung, bladder, kidney and liver. Chronic arsenic exposure is also a major risk factor for ischemic heart disease and Blackfoot Disease, a form of severe peripheral vascular disease associated with systemic atherosclerosis, dry gangrene, and spontaneous amputations of affected extremities.

Columbia University’s research program in Araihazar, Bangladesh

The CU-SBRP is a large-scale, multi-disciplinary program staffed by health scientists, earth scientists, geochemists, and social scientists, aimed at studying the health effects and geochemistry of arsenic. Four of the SBRP’s seven projects are located in Araihazar, Bangladesh, a region located approximately 30 km northeast of Dhaka (Figure 1). This region was selected because it has a wide range of concentrations of arsenic in well water, permitting dose-response studies, and because it is within reasonable commuting distance from Dhaka. Our data on socioeconomic status (SES), and that of Columbia University’s Center for International Earth Science Information Network (CIESIN), indicate that this region is not particularly poor by Bangladesh’s standards.

The centerpiece of the health sciences is a prospective cohort study, the Health Effects of Arsenic Longitudinal Study, of 12,000 Bangladeshi adults followed at two-yearly intervals. Using the infrastructure established by the CU-SBRP, additional studies supported through individual NIH grants have developed, including the Nutritional Influences on Arsenic Toxicity (NIAT) studies presented below.

Folate and arsenic metabolism

In Bangladesh, the predominant form of arsenic in drinking water is trivalent inorganic arsenic (InAsIII). InAsIII undergoes hepatic methylation with S-adenosylmethionine (SAM), a product of folate-dependent one-carbon metabolism, as the methyl (CH3) donor. One-carbon metabolism is comprised of a series of oxidation/reduction reactions that provide carbon groups for the synthesis of nucleic acids and for the generation of methyl groups used in a multitude of important transmethylation reactions, including the methylation of InAsIII.

Methylation of InAsIII yields methylarsonic acid (MMAsV) and S-adenosyl-homocysteine (SAH). SAH hydrolysis generates homocysteine and adenosine. MMaVs is reduced to MMaV prior to acquiring a second methyl group from SAM, yielding dimethylarsinic acid (DMAVs). Several enzymes have been identified that are capable of catalyzing these transitions. The regeneration of SAM and removal of the product inhibitor, SAH, are achieved largely by downstream remethylation of homocysteine by methionine synthase using 5-methyltetrahydrofolate as a cosubstrate. Folate deficiency is associated with high circulating concentrations of homocysteine or hyperhomocysteinemia (HHcys), and high concentrations of SAH.
Methylation of arsenic facilitates urinary arsenic elimination, as DMA is rapidly excreted in urine, and DMaSv is less toxic than InAs or MMAs. For these reasons, arsenic methylation has been considered to be a detoxification process. In human populations, case-control studies indicate that individuals with relatively lower proportions of urinary DMaS and higher proportions of MMAs in urine are at increased risk for arsenic-related health outcomes, including skin lesions, skin and bladder cancers, and cardiovascular disease.7, 15–18

Clinical manifestations of arsenic toxicity vary considerably between individuals and populations, and poor nutritional status is thought to confer greater susceptibility.19 Earlier nutrition studies in arsenic-exposed populations focused on antioxidants, such as β-carotene, because of their association with cancer outcomes.7, 8 A more recent cross-sectional study assessed dietary intake using food frequency questionnaires from subjects from two arsenic-exposed regions in the western United States. This study compared urinary arsenic metabolites to dietary intake of 30 nutrients. Subjects in the lowest quartile for protein intake were found to have higher %MMAs (14.6% vs. 11.6%, p = 0.01) and lower %DMAs (72.3% vs. 77.0%, p = 0.01), compared to subjects in the highest quartile for protein intake.20 A case-control study in West Bengal, India, found an increase in risk for arsenic-induced skin lesions among individuals who fell within the lowest quintiles for dietary intake of animal protein, folate, calcium, and fiber.21

We hypothesized that folate deficiency and HHcys would be associated with decreased arsenic methylation; several lines of evidence from animal studies support this notion. For example, methyl donor deficiency induced by methyl-deficient diets has been shown to significantly decrease total urinary arsenic excretion in mice and in rabbits, mainly due to lower DMaS excretion. These diets also gave rise to increased retention of arsenic in liver and lung tissues, which are prone to developing arsenic-related cancers in humans.23 More recently, an elegant series of studies on arsenic-induced NTDs employed mice nullizygous for folate binding protein-1, -2, and reduced folate carrier-1.24–27 These studies demonstrated that for all genotypes studied (including wildtype), dietary folate deficiency caused a reduction in the total amount of arsenic excreted in the urine, primarily due to a reduction in DMaS. While these studies provide strong experimental evidence that nutritional regulation of one-carbon metabolism influences arsenic methylation, excretion, and toxicity, the arsenic doses were quite high, and the dietary deficiencies were severe. Moreover, there are marked species variations in the efficiency of arsenic methylation.28

Summary of the results of the NIAT studies

• There is a high prevalence of folate deficiency and hyperhomocysteinemia (HHcys) in Araihaazar, Bangladesh.29 To determine the prevalence of folate-deficiency and HHcys in our study area, we analyzed plasma concentrations of folate and total homocysteine (tHcys) in a random selection of 1,650 Bangla-

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Hyperhomocysteinemia defined by NHANES as ≥ 10.4 µM for females and ≥ 11.4 µM for males

* p<0.01; ** p<0.0001, Wilcoxon test for gender differences; for gender differences in % variables, Chi square test was used.

The results of this survey, presented in Table 1, indicate a very high prevalence of HHcys, particularly among males. This finding is important irrespective of arsenic because HHcys is associated with increased risk for cardiovascular disease, stroke, hypertension, Alzheimer’s disease, and during pregnancy is a primary risk factor for neural tube defects. The high prevalence of HHcys is consistent with other earlier reports, which indicate that plasma tHcys concentrations are higher among Asians residing in the UK than their white European counterparts.\textsuperscript{30, 31}

Folate deficiency and hyperhomocysteinemia are associated with decreased arsenic methylation. Urinary arsenic metabolites were measured in a subset of 300 of the subjects from this cross-sectional study.\textsuperscript{32} Spearman correlations between tHcys, folate and cobalamin and uAs metabolites revealed that plasma folate concentrations were inversely correlated with %InAs and %MMAs in urine, and positively correlated with %DMAs (\(p < 0.05\) for all). HHcys was positively correlated with %MMAs (\(p < 0.001\)) and negatively correlated with %DMAs (\(p < 0.01\)). The results were similar after further adjustment for covariates. Cobalamin concentrations were not significantly correlated with arsenic metabolites in urine, however, cobalamin-deficient participants were excluded from this study. Thus, the results of this cross-sectional study indicated that adequate folate nutritional status is necessary to facilitate both the first and second methylation steps, and suggested that folate supplementation may thereby increase arsenic excretion in urine.

- Folate deficiency and hyperhomocysteinemia are associated with decreased arsenic methylation. Urinary arsenic metabolites were measured in a subset of 300 of the subjects from this cross-sectional study.\textsuperscript{32} Spearman correlations between tHcys, folate and cobalamin and uAs metabolites revealed that plasma folate concentrations were inversely correlated with %InAs and %MMAs in urine, and positively correlated with %DMAs (\(p < 0.05\) for all). HHcys was positively correlated with %MMAs (\(p < 0.001\)) and negatively correlated with %DMAs (\(p < 0.01\)). The results were similar after further adjustment for covariates. Cobalamin concentrations were not significantly correlated with arsenic metabolites in urine, however, cobalamin-deficient participants were excluded from this study. Thus, the results of this cross-sectional study indicated that adequate folate nutritional status is necessary to facilitate both the first and second methylation steps, and suggested that folate supplementation may thereby increase arsenic excretion in urine.

- Folic acid supplementation to folate-deficient Bangladeshi adults results in increased arsenic methylation.\textsuperscript{33} A random sample of 200 of the 550 participants, who fell into the lowest tertile of plasma folate in our survey of 1,650, was subsequently enrolled in a randomized, double-blind folic acid (FA)
intervention trial to determine if FA supplementation to folate-deficient adults could increase arsenic methylation. As is shown in Figure 3, supplementation with 400 µg/d FA (i.e. the US Recommended Daily Allowance) for a period of 12 weeks significantly lowered %InAs and %MMAs, and increased %DMAs in urine. Some of these effects were apparent after only one week of FA supplementation.

• FA supplementation to folate-deficient Bangladeshi adults lowers blood arsenic concentrations. Based on our understanding that arsenic methylation facilitates urinary arsenic elimination, and our observation that FA supplementation increased arsenic methylation, we hypothesized that increased arsenic methylation with FA supplementation would lower blood arsenic concentrations. Recent methodological advances in the SBRP’s Trace Metals Laboratory, headed by Superfund PI, Joseph H. Graziano, permitted us to test this hypothesis using banked specimens from the same randomized trial by measuring total arsenic and arsenic metabolites in blood, where concentrations are an order of magnitude lower than those in urine. As is shown in Figure 4, FA supplementation resulted in a decline in total blood arsenic of 13.6 ± 2.9% as compared to 2.5 ± 3.2% for the placebo group (p = 0.01). These declines were essentially identical after further adjustment for age, sex, and BMI. The decline in blood arsenic was largely due to the decline in MMAs in blood. Whereas the total decline in blood arsenic was 1.7 µg/L on average, that in blood MMAs was 1.1 µg/L.

Summary and conclusions

We have identified a very high prevalence of HHcys and marginal folate nutritional status in Araihazar, Bangladesh. Both of these conditions are associated with a decreased capacity to methylate arsenic. Furthermore, folate supplementation to folate-deficient study participants resulted in increased arsenic methylation and lowered blood arsenic concentrations.

Future directions

Additional studies are needed, including a dose-response study of efficacy, studies to determine if other agents may further enhance efficacy, and studies to determine whether FA can lower blood arsenic in populations where folate nutritional status is adequate. A nested case control of 273 incident skin lesion cases and controls individually matched for gender and age, and frequency matched for water arsenic concentrations is currently underway to determine if folate deficiency and/or HHcys are risk factors for premalignant arsenic-induced skin lesions. Large-scale, long-term interventions will be required to determine whether FA can prevent arsenic-induced skin lesions or minimize cancer risks.

References

Folic Acid and Arsenic


Combating Vitamin A Deficiency among School Children in Eight Countries
Save the Children and SIGHT AND LIFE join Forces

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Although school-age children are not at a high risk of mortality, they do suffer from a high burden of disease and micronutrient deficiencies, which affect their ability to attend school and learn to their full potential. Vitamin A deficiency is estimated to affect around 85 million school-age children, impairing their immune function and increasing their risk of infections and blindness.

Vitamin A deficiency also affects iron metabolism and studies have shown that by providing vitamin A supplements alongside iron supplements, the effect on iron status is significantly greater. Nearly 50% of school-age children suffer from iron deficiency anemia and there is substantial evidence showing that school children with anemia and/or iron deficiency score more poorly on tests of educational achievement and general reasoning compared with non-anemic children.

Most programs are implemented alongside a basic education program to improve access to and the quality of education. They all follow the internationally recognized Focusing Resources on Effective School Health (FRESH) framework, which focuses on four key program areas:

1. Health and nutrition services (deworming, iron and vitamin A supplementation),
2. Safe water and sanitation at school,
3. Promotion of healthy behaviors, and

The FRESH framework focuses on interventions that are feasible to implement even in the most re-
source-poor schools and are highly cost-effective. Because there are generally more schools than health centers, School Health and Nutrition (SHN) interventions reach more homes and more children; are cheap because they use existing education and health structures; and are one of the most effective ways of reaching the community with health and nutrition messages.

**School vitamin A campaigns in Afghanistan**

In most countries, distribution day becomes a community event and an opportunity to raise awareness about vitamin A deficiency and healthy nutrition in the community at large. In Afghanistan, children make banners, poems and small plays that they present to community members, children and adults at the schools.

These campaigns have had a tremendous effect on raising the entire community’s awareness on vitamin A and other nutritional deficiencies. Since a large proportion of children do not go to school, the campaigns also target out-of-school children to receive the vitamin A supplements and encourage them to attend school.

"Before I learned about vitamin A, my grandmother was selling the eggs from chickens, but now she cooks eggs for her and me. She says that because of receiving and eating more foods with vitamin A, I am not usually sick. So now I am sharing with all my friends and relatives what we are learning in our Child Focused Health Education groups."

— Tajmalek, 9 years old, Tagabshan, Afghanistan

Volunteer youth facilitators are trained to lead sessions with school-age children on the importance and benefits of vitamin A as well as which foods contain this essential micronutrient. Through these child-focused health education sessions, volunteer youth facilitators and participating children are able to continue raising awareness and promoting healthy behaviors throughout the year.

Between June 2006 and 2007, around 8,400 school-age children received vitamin A supplements during these campaigns. These numbers will be increasing as Save the Children expands its program into new districts.

**Promoting vitamin A-rich foods through recipes in Bolivia**

Alongside the vitamin A supplementation in schools, Save the Children developed a local recipe book, Foods Rich in Vitamin A and Iron, to encourage families to cook with vitamin A- and iron-rich foods. The book is full of pictures of tasty-looking meals made from recipes based on local dishes.

Most of the recipes are vegetarian because of the high cost of meat, and they are nutritionally analyzed so they contribute more vitamin A and/or iron than meals currently consumed. The recipes utilize whole grain products, such as quinoa and amaranth, which are available in the region but have been displaced by more western foods, such as noodles and rice.

The recipe book gained wide popularity among the community. Parents gathered in groups and brought the necessary ingredients, fuel and cooking pots from home. After cooking, everyone tasted the new recipes, talked about the importance of vitamin A and iron, and then shared the meal with their children. Some of the recipes were also prepared for a municipal nutrition fair in Caracollo and the mayor of the municipality awarded prizes to the best cooks.

In total, 8,800 vitamin A capsules were distributed in 50 schools in Caracollo and 15 schools in Oruro city. Over the next year, with new funding from GlaxoSmithKline and USAID, the SHN program will be expanding to 240 more schools in rural parts of Oruro, 300 schools in urban Oruro, and 250 schools in El Alto and Cochabamba.

**Combining vision screening and vitamin A supplementation in Bangladesh**

In Bangladesh, vitamin A supplementation at school is conducted by teachers, in conjunction with routine screening of children’s eyesight. All children receive a vitamin A supplement and those with vision problems are identified and referred for additional testing and eye glasses.
Since June 2006, nearly 90,000 vitamin A capsules have been distributed to schoolchildren in 181 schools in Brahmanbaria and Meherpur districts, and a further 4,000 capsules have been distributed through the Nutrition and Child Development Program for children under five years old in Brahmanbaria district.

Responding to emergencies in the Philippines

In the Philippines, the ready supply of vitamin A capsules was essential in contributing to Save the Children’s emergency efforts to deliver immediate relief and rehabilitation to communities affected first by the Super Typhoon in December 2006, and later by the armed conflict in Mindanao in June 2007. According to the SPHERE guidelines’ Minimum Standards during Emergencies, vitamin A should be given to all children in displaced populations.

In December 2006, in response to the destruction brought about by the Super Typhoon Reming (coded internationally as Typhoon Durian), which devastated rural communities in Camarines Sur and Albay, Save the Children supplied vitamin A capsules to the Department of Health, which in turn distributed the capsules in evacuation camps in these two provinces.

In June 2007, a mass evacuation of communities caught in the armed conflict between the military and rebel groups in the depressed provinces of Basilan and Sulu was carried out. Save the Children responded to an appeal from Christian Children’s Fund (CCF), a partner organization working in the Autonomous Region of Muslim Mindanao, by providing vitamin A capsules to the evacuation camps in Basilan, where a measles outbreak had been reported. In Sulu, displaced families in evacuation camps and host communities were also given vitamin A supplements, delivered through the USAID-funded SHIELD Project, which is being implemented by a consortium of NGOs, including Save the Children (other NGOs in the consortium are Helen Keller International, ACDI-VOCA and CCF). The supplementation was greatly appreciated by the Provincial Health Office and partner communities.

Meanwhile, Save the Children continued to distribute vitamin A within the SHN and Early Child Development programs in schools and pre-schools in poor urban communities of Metro Manila (cities of Paranaque, Taguig and Las Pinas), and in rural villages in the West Visayas region (Antique and Iloilo). In total, 95,000 capsules have been distributed to 318 schools and day care centers, and 70 pre-schools. The remaining 5,000 capsules will be used in the SHN program in 2008.

National vitamin A supplementation in schools in Malawi

The government of Malawi recently launched a national SHN program based on Save the Children’s program in Mangochi district, which has been running since 1998. Until April 2007, Save the Children was among only a handful of organizations in Malawi providing vitamin A to school children. Between June 2006 and April 2007, Save the Children provided vitamin A capsules, donated by SIGHT AND LIFE, to 171 schools and 63,000 school children in Mangochi and Balaka districts, until the government took over these activities. The remaining capsules are currently being used by Save the Children’s Community-based Therapeutic Care (CTC) program in Mangochi.

Challenges with government policy in Tajikistan

In Tajikistan, the Ministry of Health unfortunately did not give permission to Save the Children to distribute vitamin A in schools since there is no national policy recommending vitamin A supplementation in schools. The vitamin A capsules are therefore being sent to Afghanistan to be used in their SHN program.

References

The National Family Health Survey (NFHS) in India

The first National Family Health Survey (NFHS-1) was launched in 1992–93 to collect comprehensive and nationally representative data on the health and nutrition situation of India. NFHS-2 was conducted in all 26 states of India in 1998–99, collecting additional information on the quality of health and family planning services, reproductive health, and anemia rates in women of reproductive age (15–49 years) and children under three years of age.

With the third National Family Health Survey (NFHS-3) completed in 2005–06, data are now available to examine secular trends over time, for taking stock of the performance of existing public health policies and programs, and for adopting strategies to target and focus on areas requiring work. NFHS-3 was conducted in 29 Indian states, including three newly created ones, namely Jharkhand, Uttaranchal and Chhattisgarh. A total of about 199,000 women aged 15–49 years and men aged 15–54 years of age were interviewed. For the first time, testing for HIV was included to obtain estimates of population-based prevalence rates of HIV-1 infection. More than 100,000 women and men were tested during the household survey. Also for the first time, blood hemoglobin was assessed among men. The following is a brief summary of the nutritional profile of the population groups surveyed in the recent NFHS-3. Temporal trends in rates of under and over-nutrition and micronutrient deficiencies are also described. State-level data on health, nutritional and program indicators were used to assign ranks to the states surveyed.

NFHS-3 methodology

Details of the survey methodology are available in the full report (available online at http://www.nfhsindia.org/nfhs3_national_report.html). Briefly, a random multi-stage cluster sampling method was used to select the survey sample. The targeted sample was determined on the basis of the sizes of the states. Since a large number of key indicators to be estimated pertained to married or previously-married women of reproductive age (15–49 years), the sample size for each state was estimated for the required number of completed interviews of such women. The sample size was further increased in a few states to meet the need for estimating HIV prevalence as well as to obtain slum and non-slum estimates in selected cities. States were stratified into urban and rural areas or population groups, and samples drawn separately and proportionately from each area or population group. In rural areas, villages were stratified by geographical region, size, proportion of males involved in non-agriculture sectors, and proportion of the population belonging to scheduled castes or tribes, and female literacy. In urban areas, households were randomly selected within wards and blocks. This stratification allowed for the selection of a nationally-representative sample in terms of the distributions of these variables.
The main survey instruments were questionnaires designed for households, women and men. Weight and height or length measurements of children under five years old were recorded using standard procedures and equipment. Weight and height measurements of women and men were taken to calculate Body Mass Index (BMI, kg/m²). In NFHS-3, anemia prevalence among children aged 6–59 months, women, and men was estimated. Hemoglobin (Hb) concentration was estimated by finger prick with the HemoCue machine (HemoCue AB, Sweden). Salt used by the households for cooking was tested for iodine content using a rapid-test kit. Dried Blood Spots were also collected from both male and female respondents for HIV testing.

Sample characteristics

Altogether, 124,385 women aged 15–49 years and 95,403 men aged 15–54 years were surveyed, with a 94% and 87% response rate, respectively. Two-thirds of the sampled population was rural. The mean household size was 4.6, down from 4.8 in 1998–99 and 5.2 in 1992–93. Sixteen percent of women aged between 15–19 years were pregnant or mothers at the time of the survey, only slightly lower from the previous survey (16.4%). About 44% of women and 29% of men married before reaching India’s legal age for marriage, which are 18 and 21 years, respectively.

Health and development indicators

Infant mortality rate (IMR) was 57 per 1,000 live births during the NFHS-3 survey (Figure 1). A declining trend in IMR was observed, nationwide, with the decrease being higher among rural than urban areas. In part, this reflects poor health care access in the latter, perhaps due to expanding urban slum settlements where poverty, malnutrition and poor health may converge. Total fertility rate (TFR) was 2.7, down from 2.9 in NFHS-2. A third of the states in NFHS-3 were equal to or below population replacement levels (TFR ≤ 2.1). In NFHS-1 and -2, literacy rates were self-reported. In NFHS-3, a literacy test was given to all respondents with education levels of up to 5th grade or less. Literacy rates went up in NFHS-3 (55% among women, and 78% among men), compared with 51% and 74%, respectively, in NFHS-2. Gender disparity in education continues to exist despite policy and programmatic emphasis on female literacy.

Nutritional status in NFHS-3 and temporal trends

**Childhood undernutrition**

NFHS-3 estimates of the prevalence of stunting (height-for-age < -2 z score), wasting (weight-for-height < -2 z score) and underweight (weight-for-age < -2 z score) among children under three years old were based on the new 2006 WHO Child Growth Standards. Undernutrition among children continues to remain a problem of public health significance in India. However, there was an encouraging decline in the prevalence of stunting from 51% in NFHS-2 to 45% among children under three years old (Figure 2). This decline, accompanied by a small decrease in the prevalence of underweight in the past seven years (from 43% in NFHS-2 to 40% in NFHS-3), resulted in a slight increase in the prevalence of wasting from 20% in NFHS-2 to 23% in NFHS-3. Urban children were less likely to be undernourished, compared to...
National Family Health Survey of India

Less than a quarter of the infants were breastfed within an hour of birth and 57% within a day. Exclusive breastfeeding for six months continues to be low at 46.4%, with no change since NFHS-2 (46.5%). Only 21% of children aged 6–23 months were fed according to three appropriate infant or child feeding practices.

India’s large Integrated Child Development Services Program started in 1975 and aims to provide nutrition (including access to supplementary food), health and other services to preschool children, and pregnant and lactating women. NFHS-3 data revealed only a third of children aged under six years old to be receiving any services from the Anganwadi Center, the local center from where supplementary food and other health services are delivered to participants.

Adulthood malnutrition

The prevalence of underweight (< 18.5 kg/m²) among women remained high (35.6%) (Figure 3). Men also experienced a high rate of low BMI (< 18.5 kg/m²) at 33.7%. The prevalence of overweight or obesity (BMI ≥25 kg/m²) was higher among women than men. Obesity (BMI ≥30 kg/m²) was less common at 3% and 1% among men and women, respectively. Among women, overweight or obesity was more pronounced in urban than in rural areas. Interestingly, the rates of underweight and overweight or obesity were very similar in the urban populations whereas underweight was still more common in rural settings (Figure 4). While undernutrition rates in children and women continue to remain high, there appears to be a small trend towards an increasing prevalence of overweight and obesity, at least among women for whom data are available from the previous surveys. Thus, co-existence of underweight and overweight due to the nutrition transition is becoming more apparent, but mainly in urban populations only, at least for the time being.

Figure 3: Adulthood underweight and overweight or obesity prevalence rates.

Underweight was defined as BMI <18.5 kg/m²
Overweight or obesity was defined as BMI >25.0 kg/m²

Data sources:
NFHS-3, India, 2005–06, Table 10.22.1, page 304
NFHS-2, India, 1998–99, Table 10.22.1, page 304

Figure 4: Trends in overweight or obesity and underweight prevalence among women of reproductive age.

Underweight was defined as BMI <18.5 kg/m²
Overweight/Obesity was defined as BMI >25.0 kg/m²

Data source: NFHS-3, India, 2005–06, Tables 10.22.1&2, pages 304 & 306

Figure 5: Trends in anemia prevalence among women and children aged 6–35 months of age.

Data sources:
NFHS-3, India, 2005–06, Table 10.14, Page 291 and Table 10.24.1, page 311
NFHS-2, India, 2005–06, Table 7.6, page 249
Micronutrient status

Anemia prevalence among children (Hb < 11 g/dL), pregnant women (Hb < 11 g/dL), and women of reproductive age (Hb < 12 g/dL) was high at 79%, 59%, and 56%, respectively, and appears to have increased overall since the last survey, though more so in rural than in urban areas (Table 1, Figure 5). NFHS-3 also revealed about 25% of Indian men to be anemic (Hb < 13 g/dL). The prevalence was uniformly higher in rural populations across gender and age groups. It is not clear why anemia rates in women and children have increased since the last survey.

Among women, the continuing low coverage rates for iron-folic acid (IFA) supplement use during pregnancy and low vitamin A intake may offer some explanation. The Reproductive and Child Health (RCH) program by the Ministry of Health and Family Welfare, Government of India provides a three-month supply of daily IFA tablets to pregnant women. Only 23.1% of the women reported having consumed 90 or more IFA tablets during their most recent pregnancy. This rate is much lower than the proportion of women receiving any IFA during pregnancy, which has increased from 58% during NFHS-2 to 65% in NFHS-3 (Figure 6). Coverage in urban areas was better than in rural areas. Among children, only 4.7% had received iron supplements in the past seven days and only 15% had consumed foods rich in iron in the past 24 hours.

The Government of India’s National Plan for the Prevention of Blindness recommends the administration of an oral dose of vitamin A to all children under five years of age every six months, starting from nine months of age. In NFHS-2, a history of night blindness was ascertained for the two most recent births in the three years preceding the survey whereas, in NFHS-3, a history of night blindness during the most recent pregnancy ending in a live birth in the five years preceding the survey was used to calculate prevalence. Coverage in urban areas was better than in rural areas. Among children, only 4.7% had received iron supplements in the past seven days and only 15% had consumed foods rich in iron in the past 24 hours.

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The Government of India’s National Plan for the Prevention of Blindness recommends the administration of an oral dose of vitamin A to all children under five years of age every six months, starting from nine months of age. Only 18.1% children under five years of age had received a vitamin A supplement in the last six months. Compared with children aged 12–35 months who had received a vitamin A supplement in the past six months in NFHS-2 (17.1%), the coverage during NFHS-3 was slightly higher (24.8%; Figure 7) but did not reach the required level to impact vitamin A deficiency or childhood mortality. Night blindness among children was not assessed in NFHS-3. About 9% of women who had delivered an infant in the five years prior to the survey reported having night blindness during their recent pregnancy (Table 1, Figure 8).
Although the prevalence rate was down from the previous survey, this may be an artifact of the difference in the questions asked in the two surveys.

Iodine deficiency is the single most preventable cause of mental retardation worldwide. The Government of India adopted a universal salt iodization policy in 1983–84 but this policy was reversed in 2000. Only recently, in May 2006, was the ban on non-iodized salt reinstated. In NFHS-3, only 51% of the houses had adequately iodized salt (15+ ppm) and 47.5% of children aged 6–59 months were living in households that used adequately iodized salt (Table 1). Clinical signs of iodine deficiency among children or adults were not assessed in NFHS-3, but it has been estimated that 71 million people in India suffer from goiter and iodine deficiency disorders.2

### Health and nutritional status ranking by State

The health and nutritional status of women and children varied across the 29 states in India. In order to aggregate state-level information and compare relative performance, we ranked the states relative to each other’s performance in each of several indicators of health or nutrition. Indices were then derived from the mean of a combination of indicators to derive a further relative ranking that identified the three highest- (best overall performance) and three lowest- (poorest overall performance) ranked states (Table 2). More than one state was listed in the event of a tie.

A total of five Indices were constructed: Health, Undernutrition, Micronutrient Deficiencies, Overnutrition, and Program Coverage. The Health Index was a composite of indicators that included IMR, TFR and female literacy. Similarly, stunting, wasting and underweight prevalence were components of the Undernutrition Index; prevalence of anemia among children, pregnant women, and women of reproductive age, for the Micronutrient Deficiencies Index; prevalence of overweight or obesity among women and men, for the Overnutrition Index; and coverage of vitamin A and IFA supplements among pre-school children, 90+ IFA consumption among women during their last pregnancy, and children’s participation in ICDS supplementary feeding, for the Program Coverage Index.

### Table 1: Micronutrient status and program coverage.

<table>
<thead>
<tr>
<th>Micronutrient status</th>
<th>Micronutrient program coverage</th>
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</thead>
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<tr>
<td>Urban</td>
<td>Rural</td>
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<tr>
<td>Anemia</td>
<td></td>
</tr>
<tr>
<td>Women of reproductive age</td>
<td>50.9</td>
</tr>
<tr>
<td>Men of reproductive age</td>
<td>17.7</td>
</tr>
<tr>
<td>Children (6–59 months)</td>
<td>63</td>
</tr>
<tr>
<td>Night blindness</td>
<td></td>
</tr>
<tr>
<td>Pregnant women</td>
<td>3.7</td>
</tr>
<tr>
<td>Children (6–59 months)</td>
<td>-</td>
</tr>
<tr>
<td>Iodine deficiency</td>
<td></td>
</tr>
<tr>
<td>Children (6–59 months)</td>
<td>-</td>
</tr>
<tr>
<td>- “no data available” ppm – parts per million = mg/kg</td>
<td></td>
</tr>
</tbody>
</table>

- "no data available"

Figure 8. Although the prevalence rate was down from the previous survey, this may be an artifact of the difference in the questions asked in the two surveys.
Health index ranking

Uttar Pradesh, Chhattisgarh and Madhya Pradesh were the three lowest-ranked states under the Health Index, with IMR in each being more than 70 per 1,000 live births. Goa and Kerala were ranked highest, with an IMR of 15 per 1,000 live births, followed by Manipur and Tamil Nadu, with an IMR of 30 and 30.4 infant deaths per 1,000 live births, respectively.

Table 2: Ranking of states using health and nutrition status indicators collected in NFHS-3.

<table>
<thead>
<tr>
<th>Rank</th>
<th>HEALTH INDEX</th>
<th>NUTRITIONAL INDICES</th>
<th>Program coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Highest</td>
<td>Manipur, Sikkim</td>
<td>Chhattisgarh</td>
</tr>
<tr>
<td>States</td>
<td>ranking</td>
<td>Punjab, Mizoram</td>
<td>Madhya Pradesh,</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Manipur</td>
<td>Meghalaya</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Sikkim</td>
<td>Tripura</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Tamil Nadu, Sikkim</td>
<td>Goa</td>
</tr>
<tr>
<td>Lowest</td>
<td>ranking</td>
<td>Madhya Pradesh</td>
<td>Punjab</td>
</tr>
<tr>
<td>States</td>
<td></td>
<td>Bihar</td>
<td>Kerala</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>Meghalaya</td>
<td>Jharkhand</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Bihar</td>
<td>Andhra Pradesh,</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Jharkhand</td>
<td>Assam</td>
</tr>
</tbody>
</table>

| Highest | Manipur, Sikkim, Punjab, Mizoram | Madhya Pradesh, Meghalaya, Tripura |
|         | Goa, Manipur, Kerala             | Madhya Pradesh, Meghalaya, Tripura |
| Program coverage | Jharkhand, Chhattisgarh, Madhya Pradesh, Meghalaya, Tripura |
|                | Punjab, Kerala, Jharkhand, Delhi |
|                | Uttar Pradesh, Rajasthan, Manipur |

*Ranked using rates of infant mortality, total fertility and women’s literacy.
*Ranked using prevalence of stunting (HAZ score < -2) wasting (WHZ score < -2) and underweight (WAZ score < -2).
*Ranked using anemia prevalence among children 6–59 months (Hb < 11.0 g/dL) and women of reproductive age (Hb < 12.0 g/dL).
*Ranked using overweight or obesity (BMI > 25 kg/m²) prevalence among men and women of reproductive age.
*Ranked using supplementation coverage rates of iron among children, 90+ iron-folic acid supplements consumed by women of reproductive age during last pregnancy, vitamin A supplementation in the six months prior to the survey among children (aged 6–59 months), and percentage of children under six years of age who received supplementary food from the Anganwadi Center in the 12 months prior to the survey.

Health Index and Uttar Pradesh, Bihar and Jharkhand ranked lowest.

Ranking by nutritional indices

Undernutrition

Manipur, Sikkim, Punjab and Mizoram had the lowest prevalence of stunting, wasting and underweight, the three indicators combined in the Undernutrition Index. The lowest-ranked states were Madhya Pradesh, Bihar and Meghalaya. All the states with higher undernutrition rates are also the bigger and more populous states in the country.

Micronutrient deficiencies

Goa, Manipur, Kerala, and Mizoram were the highest-ranked states in the Micronutrient Deficiencies Index, i.e. they had the lowest
prevalences of micronutrient deficiencies. Bihar, Jharkhand, Andhra Pradesh and Assam ranked lowest.

Overnutrition

Among the highest-ranked states for the Overnutrition Index were Jharkhand, Chhattisgarh, Madhya Pradesh, Meghalaya and Tripura; these same states ranked low on the Undernutrition Index. On the other hand, Punjab, Kerala and Delhi had the highest rates of overweight and obesity and were ranked lowest on this Index.

Nutrition program coverage

Overall, Mizoram, Tamil Nadu, and Goa were the highest-ranked states, with the highest coverage rates for nutrition programs, while Uttar Pradesh, Rajasthan and Manipur were the lowest-ranked. Much work needs to be done to strengthen the existing programs, which continue to have generally low coverage rates throughout the country.

Conclusion

Despite the declining infant and under-five mortality rates in India, the rates of undernutrition and micronutrient deficiencies continue to remain at unacceptably high levels. The prevalence of childhood stunting has declined, although wasting malnutrition has not and may have even increased slightly since the previous survey. This indicates that children under three years of age may have become taller but slightly thinner over the past 6–7 years.

In urban India, undernutrition and overweight or obesity appear to have reached equal proportions of the population, although obesity rates are still quite low. This suggests that the burden of the co-existence of under and over-nutrition will continue to grow, especially with growing urbanization in the country.

The prevalence of anemia appears to have increased in young children and in women of reproductive age, perhaps due to the continued inadequate use of IFA and poor dietary quality. Other etiologies of anemia may play a role but remain unknown and could vary by region. India continues to have a lower than acceptable coverage for vitamin A supplementation among children and iodized salt utilization in homes. It is very clear that, unless the current, extremely low coverage rates of nutrition programs – including participation in the ICDS program – are not urgently addressed, undernutrition and micronutrient deficiencies among young children and women of reproductive age will continue to remain high. The nutritional status of men who are not targeted by existing programs may also need attention.

References

Night Blindness among Pregnant Women
A study in a rural block of Uttarakhand State, India

Priyali Pathaka, Umesh Kapila, Rita Singh Raghuvanshi, Vinita Singh, Sada Nand Dwivedi, Rajvir Singh

Introduction
Recent data indicate that vitamin A deficiency (VAD) among women of reproductive age may increase morbidity and mortality during pregnancy and the early postpartum period. Maternal night blindness due to VAD, which commonly occurs during pregnancy in vitamin A deficient populations, has been widely used in community-based studies as an indicator of the prevalence of VAD. However, limited data on VAD prevalence among pregnant women in Uttarakhand State, India, led to the implementation of a community-based study from July 1999 to February 2001.

Methods
The study, a community-based cross-sectional survey, was conducted among pregnant women in a rural block of District Udham Singh Nagar in Uttarakhand State. Sixteen villages were randomly selected and all the pregnant women were enrolled. Women suffering from chronic illnesses affecting their dietary patterns or suffering from acute morbidity conditions in the last 15 days of the survey were excluded from the study. Researchers obtained approval for the study from the Ethics Committee of the All India Institute of Medical Sciences in New Delhi, and the study’s objectives were explained to the selected women to gain their informed consent.

Researchers collected data on sociodemographics, anthropometric measurements (weight and height), and obstetric history through home visits, and assessed vitamin A deficiency by the presence of clinical signs of night blindness using a pre-tested proforma. Pregnant women found to be night blind were classified as vitamin A deficient.
Researchers applied a 24-hour dietary recall methodology to collect dietary intake data for vitamin A and calories. They recorded the amount of raw food used for cooking the family meal, the total volume of food cooked, and the volume of cooked food consumed by the enrolled woman. With these data, they calculated the amount of raw food consumed and the consequent nutrient intake of women, basing their calculations on food composition data published by the National Institute of Nutrition, Indian Council of Medical Research (ICMR). The recommended dietary allowances (RDA) suggested by the ICMR were used to assess the adequacy of nutrient intake.

The collected data were subjected to statistical tests performed with the SSPS-11.0 Statistical Software. Multivariate logistic regression analysis was performed; crude Relative Risk (RR) and their Confidence interval (CI) at 95% were calculated. Variables included in the analysis were age, anthropometric weight, parity, and dietary intake of vitamin A.

Results

A total of 351 pregnant women were enrolled in the study. The mean age of the women was 20.6 ± 3.95 years. The majority of them (54.4%) was less than 20 years of age. Anthropometric measurements revealed that 16.2% of the women were malnourished (BMI < 18.5 kg/m²). Data on pregnancy duration revealed that 17.9%, 30.8%, and 51.3% of the women were in their first, second and third trimesters, respectively.

It was found that 10% (N=35) of the pregnant women were suffering from VAD. The majority of the women were in their third trimester (Table 1). Multivariate logistic regression analysis revealed that young women (aged <19 years) were at a 2.5 times higher risk of suffering from VAD compared to women over 19 years of age (p = 0.01).

Data on dietary intake revealed that 81.4% and 22.3% of the subjects were consuming vitamin A and calories at levels lower than 50% of the RDA. The data also showed that women with VAD had a lower intake of vitamin A compared to the other women (382 vs 229 IU/day).

Discussion

The study revealed a high prevalence of VAD (10%) among the pregnant women of the rural area studied. Earlier data from population-based studies conducted in rural areas of India reported the prevalence of VAD among pregnant women to be 2.9%, 4.8%, 6%, 15.9%, and 38.9%. The recent National Family Health Survey, three of which were conducted in India, reported a prevalence rate of 9% for VAD among pregnant women. A multi-centric study conducted in 16 districts of India reported the prevalence of VAD among pregnant women to be in the range of 0.59 – 19.6%.

Studies conducted in the Southeast Asian region have reported prevalence of VAD among pregnant women to be 8.1% regionally; 16.7% in Nepal, 12.8% in Bangladesh, 6.5% in Indonesia, 3.7% in Sri Lanka, and 7.2% in the Philippines. The study documented that VAD is still an important public health problem among pregnant women in rural areas of the Udham Singh Nagar district, and that large numbers of pregnant women are suffering from night blindness. While the high prevalence of VAD was possibly due to inadequate dietary vitamin A intake, recent studies have shown that iron deficiency may limit the efficacy of vitamin A to normalize dark adaptation in pregnant women. The National Family Health Survey reported that 59% of the pregnant women in India are anemic, of which almost 47% are in Uttranchal State.
There is a clear need to improve the vitamin A intake of pregnant women by planning and implementing supplementation programs in the study areas. Pregnant women also need to be better counseled on improving their dietary intake of vitamin A.

References


Just six months from now the International Agency for the Prevention of Blindness (IAPB) will hold its Eighth General Assembly. Following are the details:

Theme : "Excellence and Equity in Eye Care"
Venue : Hotel Panamericano, Buenos Aires, Argentina.

The Assembly is co-sponsored by the World Health Organization (WHO) and seeks to involve the entire spectrum of eye care workers, from ophthalmologists to public health experts to rehabilitation professionals.

The event promises to be stimulating and worthwhile for all interested in the success of VISION 2020: The Right to Sight.

Registrations and hotel reservations are in progress. For more information and to make your bookings, please visit the Assembly website: 8ga.iapb.org or write to us at agency@lvpei.org
Vitamin A Deficiency in Ethiopia in the Last 50 Years

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Email: hjemal@hotmail.com

Introduction

Ethiopia is among the Sub-Saharan African countries with the highest rates of macro- and micronutrient deficiencies, caused by the interaction of poor or inadequate diets and infectious diseases. These factors stem from poverty, low agricultural production, deeply entrenched food habits, and repeated droughts and famines.1–3 This review aims to examine the distribution of vitamin A deficiency during the last 50 years and the impact of major intervention measures.

Ethiopia’s economy is based on subsistence agriculture, with about 85% of the projected population of 77 million living in rural areas, mostly concentrated in the agricultural highland areas. There are around 80 ethnic groups,4 many with distinct agricultural systems and diets. Nationally, the major grain and pulse crops cultivated are maize, teff (*Eragrostis tef*), wheat, barley, fava beans and millet, but there are also large areas in southwestern Ethiopia where ensete (*Enset ventricosum*), commonly known as false banana, dominates, and where tubers and green vegetables are more widely grown5 and consumed. Pastoralism prevails in the semi-arid lowlands, where milk products and supplementary grains constitute the main diet.

Vitamin A deficiency (VAD) is a major public health problem contributing to most of the child morbidity, mortality and blindness in Ethiopia.6–10 As in most developing countries, VAD in the form of xerophthalmia persists as one of the major nutritional problems of public health significance.

The distribution of xerophthalmia and related eye diseases

One of the first reports on clinical vitamin A deficiency in Ethiopia dates to the mid-1920s. Subsequent community-based, as well as national studies have revealed that most parts of the country harbor high levels of clinical and sub-clinical VAD. The clinical picture does not always reflect vitamin A intake and serum levels. Despite various interventions, VAD remains a major public health problem among preschoolers, school children and mothers in Ethiopia.

One of the first investigators to report VAD in Ethiopia was Postmus,9 who examined 7,000 pre-school and school-aged children in Addis Ababa from 1957 to 1958. He found Bitot’s Spots to be prevalent among 9% of the girls and 2.2% of the boys while approximately half of them had conjunctival xerosis. The 1959 survey by the Inter-Departmental Committee on Nutrition for National Defence (ICNND) indicated that about 10% of pregnant women had vitamin A levels of less than 10 µg/dL.10 That survey also found Bitot’s Spots in 20% of males and 0.4% of females, and analysis of the low per-capita dietary intake indicated that VAD was widespread. Subsequent community-based, as well as national studies have shown VAD to be a major public health problem (Table 1).

The 1971 household-based dietary studies conducted by Selenius et al found toddlers’ intake of vitamin A to be deficient.11, 12 The group also noted an intake of less than 40% of
the required vitamin A intake among 30% of the children in the former Arsi (cereal/cropping zone) and Sidamo (ensete zone) administrative regions. A national assessment of vitamin A status was carried out by the former Ethiopian Nutrition Institute (ENI) in 1979 among 6,636 preschoolers in 42 rural communities in four agro-ecological zones.\textsuperscript{13} Bitot’s Spots were found among an average of 1.0% of all children in all four zones – twice the cut-off point set by the WHO for public health significance. Based on this rate, an estimated 6 to 8 million children aged under six years were considered to be at risk of VAD in the country. Higher prevalences of Bitot’s Spots was found among children in pastoral areas (1.6%), followed by grain-cropping

<table>
<thead>
<tr>
<th>Authors (references)</th>
<th>Survey year and major agro-ecological zone*</th>
<th>Group assessed**</th>
<th>Type of assessment</th>
<th>Biochemical (LSR)</th>
<th>Dietary intake</th>
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<tbody>
<tr>
<td>Postmus (6)</td>
<td>1957/58\textsuperscript{C}</td>
<td>Children \textsuperscript{a}</td>
<td>Clinical (xerophthalmia) 2.2 – 9%</td>
<td>ND#</td>
<td>Below RNI##</td>
</tr>
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<td>ICNND (7)</td>
<td>1959\textsuperscript{All}</td>
<td>Children \textsuperscript{c} &amp; women</td>
<td>0.4 – 20%</td>
<td>10% in mothers</td>
<td>ND</td>
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<td>Selinus et al (11,12)</td>
<td>1971\textsuperscript{PC}</td>
<td>Children \textsuperscript{a}</td>
<td>ND</td>
<td>ND</td>
<td>30% below RNI</td>
</tr>
<tr>
<td>Lindtjørn (14)</td>
<td>1981\textsuperscript{C}</td>
<td>Children \textsuperscript{a}</td>
<td>5.4%</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>Pizarello (16)</td>
<td>1984/85\textsuperscript{C}</td>
<td>Children \textsuperscript{a}</td>
<td>2 – 4.8%</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>DeSole et al (17)</td>
<td>1987\textsuperscript{C}</td>
<td>Children \textsuperscript{a}</td>
<td>5.0%</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>Foster (15)</td>
<td>1988\textsuperscript{C}</td>
<td>Children \textsuperscript{a}</td>
<td>0.8 – 11%</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>Haidar (18)</td>
<td>1993\textsuperscript{C}</td>
<td>Children \textsuperscript{a}</td>
<td>10.0%</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>Haidar et al (19)</td>
<td>1994\textsuperscript{C}</td>
<td>Children \textsuperscript{a}</td>
<td>18.8%</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>Haidar (20)</td>
<td>1993\textsuperscript{C}</td>
<td>Children \textsuperscript{a}</td>
<td>20.0%</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>Fiseha T (22)</td>
<td>1993\textsuperscript{C}</td>
<td>Children \textsuperscript{a}</td>
<td>8.9 – 10.9%</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>Tafese et al (23)</td>
<td>1993\textsuperscript{C}</td>
<td>Children \textsuperscript{a}</td>
<td>8.9 – 10.9%</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>ENI (24)</td>
<td>1993\textsuperscript{C}</td>
<td>Children \textsuperscript{a}</td>
<td>2.3%</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>Tafese et al (25)</td>
<td>1994\textsuperscript{C}</td>
<td>Children \textsuperscript{a}</td>
<td>3.5%</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>Nigusse Z (26)</td>
<td>1994 – 95\textsuperscript{C}</td>
<td>Children \textsuperscript{b}</td>
<td>36.5%</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>Haidar et al (27)</td>
<td>1995\textsuperscript{C}</td>
<td>Children \textsuperscript{b}</td>
<td>9.8%</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>Haidar et al (28)</td>
<td>1994\textsuperscript{C}</td>
<td>Children \textsuperscript{b}</td>
<td>9.8%</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>Haidar et al (29)</td>
<td>1994\textsuperscript{C}</td>
<td>Children \textsuperscript{b}</td>
<td>9.9%</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>Wold Gebriel et al (30)</td>
<td>1997\textsuperscript{C}</td>
<td>Children \textsuperscript{a}</td>
<td>14%</td>
<td>ND</td>
<td>ND</td>
</tr>
<tr>
<td>Haidar et al (31)</td>
<td>1996\textsuperscript{C}</td>
<td>Children \textsuperscript{b}</td>
<td>0.2 – 7.6%</td>
<td>28.2 – 96.4%</td>
<td>Below RNI</td>
</tr>
<tr>
<td>Haidar et al (32)</td>
<td>1996\textsuperscript{C}, CC</td>
<td>Children \textsuperscript{b}</td>
<td>1.5%</td>
<td>62.3%</td>
<td>Below RNI</td>
</tr>
<tr>
<td>Haidar et al (33)</td>
<td>1996\textsuperscript{All}</td>
<td>Children \textsuperscript{b}</td>
<td>0.2 – 9.9%</td>
<td>37.0 – 97.8%</td>
<td>Below RNI</td>
</tr>
<tr>
<td>Demisie et al (34)</td>
<td>1996\textsuperscript{E}</td>
<td>Children \textsuperscript{b}</td>
<td>0.2%</td>
<td>37.0%</td>
<td>Below RNI</td>
</tr>
<tr>
<td>Demisie et al (35)</td>
<td>1997\textsuperscript{E}</td>
<td>Children \textsuperscript{b}</td>
<td>0.5 – 4.3%</td>
<td>43.8 – 91.6%</td>
<td>Below RNI</td>
</tr>
<tr>
<td>Demisie et al (36)</td>
<td>1997\textsuperscript{E}</td>
<td>Children \textsuperscript{b}</td>
<td>0.9 – 6.4%</td>
<td>68.4%</td>
<td>Below RNI</td>
</tr>
<tr>
<td>Haidar et al (37)</td>
<td>1997\textsuperscript{C}, CC</td>
<td>Children \textsuperscript{b}</td>
<td>0.5%</td>
<td>43.8%</td>
<td>Below RNI</td>
</tr>
<tr>
<td>World Vision Ethiopia (40)</td>
<td>1997\textsuperscript{All}</td>
<td>Children \textsuperscript{b}</td>
<td>6.4 – 7.5%</td>
<td>28.4 – 46.0%</td>
<td>ND</td>
</tr>
<tr>
<td>Demisie et al (44)</td>
<td>2005\textsuperscript{All}</td>
<td>Children \textsuperscript{b} &amp; women d</td>
<td>0.7 – 3.2%</td>
<td>ND</td>
<td>ND</td>
</tr>
</tbody>
</table>

*C = cropping/cereals, CC= cash crop, E=ensete, P=pastoralists, All=all ecological zones
**a = pocket study, b=representative survey, c=general survey, d=national survey, f=hospital based study
LSR = Low serum retinol
ND = no data
RNI = Recommended Nutrient Intake

Table 1: Vitamin A status in Ethiopia as reported by various investigators.
Vitamin A Deficiency in Ethiopia

(1.1%) and cash cropping zones (0.4%). Overall serum retinol levels were deficient in 16% and low in 44% of the children.

Surprisingly, no cases of Bitot’s spot were reported from the ensete zone. This was attributed to the high consumption of green leafy vegetables, particularly kale along with ensete. Nevertheless, further studies are needed in the ensete areas, where grain, especially maize cultivation, has become more common in some areas in recent years. Another study in the maize-vegetable-growing highlands of former Gamu Gofa Region (now located in the eastern part of Southern SNNPR Region) by Lindtjørn reported a xerophthalmia prevalence of 5.9%.

Surveys of eye clinics among new outpatients aged under six years found xerophthalmia rates of 11.9%, 0.8% and 4.5% in grain-growing areas in the former administrative regions of Bale, Wellega, and Shewa (now mostly in Oromia, southern Amhara and the northern part of Southern regions), respectively.

In a study by Wolde-Gabriel et al among a total of 240 children in a village in the former Hararge Region (now eastern Oromia), night blindness, Bitot’s Spots, corneal xerosis, corneal ulceration and corneal scars were observed in 28.8%, 6.7%, 0.8%, 6.3%, and 5.8% of the children, respectively, while the concentration of serum retinol was <0.35 µmol/L in 30.2% of them. In the two years prior to the study, there were 74 deaths (in the same study area), among which 17 were reported to have been associated with ruptured corneas.

In late 1988, a physician and a nutritionist from ENI examined 240 registered children in Melkaye village, in the former Wello Region (in eastern Oromia Region) Zone, for VAD. These children had been dependent on food aid because of continuous drought and crop failures since 1982. The food aid, the main food source, included food deficient in vitamin A and β-carotene, including wheat flour, vegetable oil, butter-oil, and beans. Nearly 53% of the boys and 43% of the girls had at least one sign of VAD, 6.7% had Bitot’s Spots, 7.1% had corneal xerosis/ulceration, while 30.2% had a serum retinol level less than 0.35 µmol/L.

Community surveys by the first author in 1991 in the grain-growing highlands of eastern Oromia Region demonstrated an overall prevalence rate of 18.8% for night blindness and 14.7% for Bitot’s Spots among 373 children below the age of 14 years in the village of Torbayo. A subsequent study conducted among 2,471 children in different localities in the same sorghum/wheat staple region revealed over 10% of Bitot’s Spots. The night blindness rate of 28.7% reported for Torbayo Village was among the highest reported in the world, although xerophthalmia rates were even higher (30.2%) in the wheat-growing areas of the former Sidamo Region (now the southern part of Oromia Region).

Intervention programs

Several attempts have been made to address the problem, but progress in the last two decades has been inadequate due to a combination of persisting low agricultural production, insufficient and imbal-
anced food consumption, high levels of infectious diseases and increasing poverty.

The first VAD intervention in Ethiopia was carried out as a collaborative project by the University of London and the Ethiopian Ministry of Health in two small towns in the then Gonder Region (now northern Amhara Region) by Miller et al in 1976. During the period 1969–1973, a combination of dietary/nutrition education and the introduction of a garden project in one town (Debarek), focusing on the production of green vegetables, was associated with a decrease of VAD from 22% to 0.6%. In the other town (Adi Arkai), where vitamin A capsules were distributed by the local polyclinic, the prevalence declined from 13% to 2.5% during the same three-year period. These results emphasize the value of preventive interventions.

Cognizant of the magnitude and seriousness of the problem, the former ENI took the initiative and used a disease-targeted approach as an interim intervention strategy with nutrition education packages starting in 1989. Subsequently several intervention activities were carried out until 1996, when the vitamin A supplementation (VAS) program was implemented at the national level.

In 1993, blinding malnutrition was reported in 17 villages of Arsi Administrative Zone, Oromia Region, among preschoolers aged between 6 and 60 months. The prevalence was high, up to 28.3% in some villages and the overall prevalence of night blindness and Bitot’s Spots were 10.9% and 8.8% respectively.22–24 To respond to this frightening situation, a mass vitamin A capsule distribution campaign was carried out in the same year by the former ENI in all affected villages. A follow-up survey conducted 6 months later showed that the prevalence of xerophthalmia in the affected villages had decreased from 10.9% to 2.0%. In the same year a high rate of night blindness was reported in Tigray Administrative Region (Figure 1) by the local health bureaus seeking assistance from the former ENI. In response, a team from ENI and an ophthalmologist from the national program for blindness control were sent to assess the situation among children aged between 6 and 60 months. They found a night blindness rate of 7.8% and a Bitot’s Spots rate of 3.4%.25

A study conducted from 1994 to 1995 in an orphanage in Jimma Town in southwestern Ethiopia, among 107 children below 16 years of age, revealed 36.5% with clinical signs of VAD.26 A collaborative community study conducted by the International Livestock Research Institute (ILRI) and Ethiopian Health and Nutrition Research Institute in 1994–1995 in a small town near Addis Ababa (Holeta) found 9.8% of preschoolers with Bitot’s Spots, which is nearly 20 times the cut-off point set by the WHO.27–28 Similar results were also found in the grain-growing highlands of central Ethiopia.29

Another study conducted in highland sorghum- and wheat-growing villages in Oromia Region by Wolde-Gabriel et al reported that 9% of the preschoolers manifested night blindness (nine times higher than the WHO cut-off point), 14% had Bitot’s Spots (28 times the WHO cut-off point) and 0.6% had corneal xerosis (60 times the WHO cut-off point).30

In an effort to scale up the intervention, two new vitamin A intervention approaches were implemented at the national level by the line ministry, with the support of UNICEF. These newly adopted approaches were EPI-Plus and Wereda Integrated Basic Service (WIBS). The EPI-Plus program aimed at improving the vitamin A status of preschoolers, lactating mothers and pregnant women through EPI and MCH activities periodically, whereas the WIBS program focused on vitamin A supplementation plus non-health measures, such as provision of horticultural seeds, and strengthening information, education and communication (IEC) activities.

In 1995, baseline surveys were conducted prior to the implementation of the two new approaches in the northern, eastern and southern parts of Ethiopia, in three agro-ecological zones where 1) cropping teff (Eragrostis tef), barley, maize culture, 2) ensete (Ensete ventricosum) culture, and 3) cash crops (coffee and chat Catha edulis) prevailed. Nearly 1.0% of 15,087 preschoolers assessed were found to have night blindness, 3.6% with Bitot’s Spots, 0.2% with corneal xerosis, 0.03% with corneal ulceration, and 0.08% with corneal scars.
The mean proportion of low serum retinol was 68.9% or six times higher than the cut-off point set by the WHO. The high prevalence of sub-clinical VAD was mainly attributed to low dietary intake of vitamin A in the mono-crop wheat culture belt of Arsi and Bale administrative zones in south-central Oromia Region. There, the prevalence of clinical xerophthalmia was below the cut-off values suggested by the WHO for public health significance. The lowest eye pathology levels were reported from the ensete areas. These results are consistent with those of an earlier study showing a significantly lower prevalence of Bitot’s Spots and corneal lesions in the ensete staple area than in grain-cropping and pastoral zones of the country. In spite of the low clinical prevalence in the ensete agroecological zone (credited to the high consumption of green leafy vegetables, cheese and butter with ensete), the region suffered sub-clinical VAD, as indicated by low serum retinol levels (27.9%).

According to the Third Report of the World Nutrition Situation of December 1997, the prevalence of clinical signs of VAD in Ethiopia, extrapolated from multiple surveys, had decreased by 32.3% within 10 years (1987–97) – which may have been attributable, in part, to the supplementation program. However, the decreasing trend could not be sustained. The impact evaluation of the above-mentioned approaches for strengthening vitamin A capsule supplementation, repeated in 1996 in the same areas (with the exception of the southern region), showed that the post-intervention prevalence rate of Bitot’s Spots was higher than the WHO cut-off point. The overall prevalence of night blindness remained nearly the same after one year of intervention and sub-clinical VAD remained largely unchanged, and 63.3% of the survey population had serum retinol levels <0.70 µmol/L. Nevertheless, marked reductions in the prevalence of Bitot’s Spots was observed, with a nearly three-fold reduction in northern highland communities, and a two-fold reduction in the highlands and lowlands of eastern Oromia and Harari regions (Figure 1).

VAD continued to be a problem even among school children residing in beneficiary villages registered under the World Vision Ethiopia Development Program, as found in the impact assessment by the Micronutrient and Health (MICAH) team among 1,246 preschoolers and 3,003 school children. The results of the study found a prevalence of night blindness of 4.0% and 11.4%, Bitot’s Spots of 6.4% and 7.5%, and serum retinol levels <0.70 µmol/L of 56.0% and 28.4% among preschoolers and school children, respectively.

The high rates of xerophthalmia in the country called for the intensification of the control and prevention program in the country. Thus, the program was scaled up to provide vitamin A twice yearly to preschoolers between 1998 and 2000. The first distribution was conducted through the national polio immunization program, and the second campaign was conducted six months later; this program achieved over 80% coverage.

Vitamin A distribution through campaigns was halted temporarily and reintroduced in 2002 in six administrative regions. Although there have been no impact studies on these interventions, their impacts on improving vitamin A status do not appear significant based on several community-level studies. The EPI-Plus and WIBS approaches were not implemented as planned due to lack of resources. These campaigns faced several problems, including the risks of beneficiaries choking or over-dosing (due to difficulties in patient tracking) and, above all, unsustainability in the absence of adequate resources. The reasons for the negligible success of the few capsule-based attempts appear to be that they were not based on accurate and specific information regarding the problems associated with food supply and the lack of a comprehensive, intersectoral approach involving the health, agriculture and education sectors.

In 2003, vitamin A capsules were distributed in all drought-affected areas, together with measles vaccination for children aged between 6 months and 14 years, in response to the emergency situation. Twenty million children received a single dose of vitamin A. To maintain the momentum of the program and reduce morbidity among preschoolers, the Ministry of Health implemented a new program of essential health services packages, the Enhanced Outreach Strategy (EOS) for child survival interventions, with support from UNICEF, commencing in 2004 in 14 drought-affected districts. The program was expanded to 325 districts in 2006, with the objective of expanding vitamin A supplementation to at least 90% of children aged 6–59 months, together with deworming, vaccination, health
education, provision of mosquito nets, screening for acute malnutrition, and referrals for food rations.42, 43

A nationally representative survey was carried out in 2005 in nine of the 12 administrative zones and in all agro-ecological regions (Gambela and Somali regions were excluded for security reasons) where the EOS had not been launched, covering a total of 11,000 households with preschoolers. Results show an average prevalence rate of 1.7% for Bitot’s Spots (95% CI 1.6% to 1.9%), which is still three times the WHO cut-off point – the highest rate was found in Amhara Region (3.2%), followed by Afar (2.1%), Oromia (1.5%), Addis Ababa (1.4%), Harari (1.2%) and Dire Dawa (1.1%) regions. The prevalence of night blindness was 0.7% (95% CI, 0.6% to 0.8%), below the WHO cut-off point, but maternal night blindness was 1.8% (95% CI, 1.7% to 2.0%), or twice the WHO cut-off point, with the highest prevalence rates in Harari (1.1%), followed by Amhara (1.0%), Beni Shangul (1.0%) and Afar (0.9%) regions (Figure 1).44

Currently, routine vitamin A delivery with EPI Plus and other programs are being promoted through a new initiative included in the new Health Extension Package as part of the Health Sector Development Program. The extension package aims to increase community awareness of dietary and nutritional issues at the village and household levels. This should focus on sustained preventive health behavior, a necessary approach to achieving the Millennium Development Goals (MDGs), which entails shifting health care resources to the most vulnerable segments of the population.45 Efforts to increase dietary intake of vitamin A-rich foods should also include the development of nutritional and dietary guidelines specific to the various agro-ecological zones of Ethiopia to encourage the cultivation and consumption of culturally acceptable vitamin A-rich foods. The recently launched health extension program, which has begun to train two female workers per kebele (the smallest administrative unit, usually comprising about 5,000–8,000 people),46 as well as agricultural extension workers and teachers, may play a significant role in promoting nutritionally balanced diets. A multi-sectoral approach promises to change deeply ingrained agricultural and dietary customs and behaviors more effectively than the singularly medical approach, which largely failed to reduce VAD in Ethiopia during the last 2–3 decades. Any strategy to improve vitamin A intake will have to consider not only qualitative but also quantitative improvements in view of the growing food insecurity that has plagued Ethiopia in recent years.47

Conclusion

This review indicates that VAD continues to be a major public health problem in Ethiopia in spite of various intervention measures since 1989. This underlines the need for sustained preventive health behavior toward achieving the MDGs, which entails shifting health care resources to the most vulnerable segments of the population. It is evident that the problem of VAD has serious implications because the MDG for child health specifically targets improvements in the rates of undernutrition.

Furthermore, this review points out that the clinical picture of VAD does not always reflect vitamin A intake and serum levels and that the condition may be under-diagnosed, indicating that clinical signs lack sensitivity. Although the current interventions focus on children 6–59 months, the supplementation program should extend to school children with identified problems of VAD, with nutrition education focused on the consumption of vitamin A-rich foods by school-aged children. All available communication media, both traditional and modern, should be used in mass communication and community-level education programs to maximize the dissemination of nutrition messages to a largely illiterate population.

References

Vitamin A Deficiency in Ethiopia

In Nepal, iron deficiency anemia (IDA) is estimated to affect eight out of 10 children under five years of age, two out of three women, and three out of four pregnant women because of insufficient dietary iron consumption.

WHO cut-offs prescribe that an anemia prevalence greater than 20% within a population indicates a significant public health problem. These alarmingly high rates warrant a review of existing policies, approaches and interventions.

In spite of efforts to control it, anemia is a severe problem in Nepal. Compliance with and coverage of the government’s health policy for all pregnant women visiting health posts to receive 60 mg of iron per day from the start of the second trimester of pregnancy, and continuing through 45 days postpartum, is low. Operational issues limit the demand for these services as well as the continuous supply of supplements through the health infrastructure.

To guide efforts to prevent and control IDA through effective Information, Education and Communication (IEC), the Helpless Rehabilitation Society – an NGO based in Kathmandu, Nepal – undertook a study to obtain baseline information on demographic and household characteristics, and the present level of Knowledge, Attitudes and Practices (KAP) relating to IDA. The study was conducted among specific high-risk demographic groups, specifically female laborers (adolescent girls, pregnant women, and nursing mothers), who were mostly migrants from the hill and mountain areas, working at carpet factories in rural and suburban areas on the outskirts of Kathmandu.

Data were collected through interviews and observations at the selected carpet factories. Researchers interviewed a total of 740 female factory workers (388 adolescent girls, 166 pregnant women, and 186 nursing mothers), selected from 20 carpet factories, over a period of one month (March 2007).
Summary of the findings

In terms of the educational status of the respondents, researchers found more than 63% were illiterate, while only 1.5% of the adolescent girls and 3.2% of the nursing mothers had undergone higher education – a key insight for the development of an IEC strategy.

In relation to knowledge on IDA, 47.8% of respondents knew the signs and symptoms of anemia, and 54.1% of respondents knew that anemia is due to iron deficiency versus 14.9% who did not. While a majority were aware that pregnant women and nursing mothers are high risk groups for IDA, 43.3% of respondents said they did not know if pregnant or nursing women and adolescent girls should have the same diet as everyone else or required more nutritious food, and 38.1% said these groups needed special attention and more nutritious food than other household members. Nearly a third of respondents could name foods rich in iron.

The majority of respondents (85.4%) generally held a positive attitude toward going to the health posts for treatment when a family member has anemia, however only 12.4% were predisposed to eating more iron-rich foods if they were anemic. Although early marriage occurs in rural areas, the majority of respondents regarded the appropriate age for marriage to be 18 years old and older.

On related practices, only 11.6% of respondents consumed a combination of foods rich in macro- and micronutrients; 57% had eaten or packed lunches rich only in carbohydrates, and 30%, only carbohydrates and protein, prior to the interview. When a family member had any symptoms of anemia, 76.2% visited a health post, 2.4% reported doing nothing, and the rest sought alternative treatments.

Large family sizes affect the consumption of iron-rich foods in a household, particularly by adolescent girls, pregnant women and nursing mothers, all of whom are least likely to be served food first. The majority of the adolescent girls interviewed reported that male members of the household were served food before the female members, and only a very small proportion (2.6%) of mothers was served first.

Recommendations

Based on the study findings, the researchers recommended the following actions:

• Given the illiteracy rate of over 63%, female carpet factory workers should be enrolled in adult literacy classes.

• With over 45% of respondents having families comprising 6–10 members, which is considered high in Nepal, and over 53% of respondents having more than four siblings, there is a strong need for family planning initiatives at the carpet factories to increase awareness of a healthy family size.

• IEC materials and activities need to be developed and disseminated through regular meetings and educational events in areas where nutritional problems exist to increase knowledge and awareness of IDA and other micronutrient deficiencies.

• Periodic nutritional assessments should be conducted among the population groups most at risk of IDA and other micronutrient deficiencies to identify people with IDA as well as deliver educational and promotional activities.

• Nutritional supplements as well as a greater awareness of micronutrient-rich foods should be provided to the children of carpet factory workers to help reduce the prevalence of nutritional problems.
Among the micronutrients with the greatest gulf between emerging scientific discovery and public health implementation is vitamin D. SIGHT AND LIFE inaugurated its Magazine series with a keynote article by Donald McLaren entitled “Vitamin D deficiency disorders (VDDD): A global threat to health.” The growing importance of this topic has been recognized by the Office on Dietary Supplements of the US National Institutes of Health (NIH), who convened a conference on the topic “Vitamin D and Health in the 21st Century: An Update” in September 2007 in Bethesda, Maryland. The National Cancer Institute, the National Institute of Arthritis and Musculoskeletal and Skin Diseases, and the American Society for Nutrition co-sponsored the event.

Formal sessions were moderated or presented by 30 international professionals from Canada, Denmark, Finland, UK and USA. The conference’s overall objectives were to:

- Evaluate the available evidence on the efficacy and safety of vitamin D.
- Identify gaps in knowledge on its efficacy and safety in general and across the life cycle.
- Inform the NIH and other US federal agencies on research priorities in the area of vitamin D and health.
- Inform the broader nutrition community with the publication of the conference proceedings.

The conference was organized into four sessions over the two days: Session 1, Vitamin D Metabolism and Status; Session 2, 25(OH)D and Functional Outcomes across the Life Cycle; Session 3, Impact of Dietary Intake (including Fortified Foods and Supplements) and
Advances in the human biology of vitamin D

Prof. Anthony Norman’s opening address provided a contemporary summary of the biological aspect of vitamin D. He began with the biosynthesis of the vitamin in the human skin and reminded the audience that a series of factors intervene to influence vitamin D production from UV-B radiation exposure, including the season of the year; amount of time and time of day spent outdoors; latitude; altitude above sea-level; air pollution; cloudiness; atmospheric ozone cap; clothing; skin pigmentation; and age.

Prof. Norman elaborated on vitamin D receptor (VDR) biology and the role of the vitamin’s metabolites in interaction with VDRs well beyond the classical tissues. Box 2 lists the tissue sites in which VDRs have recently been identified. VDRs in the nucleus are part of the genomic-based signalling for transcription regulation of protein synthesis. This is the basis of the role of vitamin D metabolites as steroid hormones. The exciting new finding is the confirmation of VDRs on cell membranes. Activation of these membrane VDRs results in the transmission of signals that activate phosphorylation enzymes that control metabolism on a minute-by-minute basis.

Another new insight is that the hydroxylation of the 24-carbon of the vitamin D structure is not simply a catabolic route. The action of the 24-hydroxylase enzyme is important and it appears that 24,25 dihydro-vitamin D₃ may have a role in fracture healing.

Finally, the new frontier of research relates to the pharmaceutical manufacture of multiple analogs of the active vitamin D moiety that can now be accomplished. This has a significance that bridges pharmacology to nutrition and back. These analogues have immunosuppressive effects, which may be important in organ transplantation and combating auto-immune diseases. They have anti-proliferative effects that can inhibit cell growth and
combined with cell differentiation effects, could prolong the survival of patients with malignant diseases. The analogs also portend beneficial effects to improve pancreatic beta-cell function in diabetes and cardiac muscular fiber function. To the extent that exposure to higher oral intakes of vitamin D supplements is advanced with new recommendations, higher amounts of diverse natural metabolites with functions identical to the synthetic analogues will arise in human tissues, exerting the protective functions in the drug applications.

Performance of biomarkers of vitamin D status

Cutting through all of the questions, the essential core of the collective inquiry was how reliable is the major biomarker of human vitamin D status, i.e. whether different levels or categories of circulating concentrations of 25(OH)D correspond to a common state of vitamin D status, as reflected in bone mineralization status. The meeting specifically focused on the validity of cut-off values for circulating 25(OH)D that are currently in vogue; these include <10 ng/mL (<25 nmol/L) as an indicator of vitamin D insufficiency; <30 ng/mL (<75 nmol/L), as a level in the “low range;” and <60 ng/mL (<150 nmol/L) as a level below “optimal” vitamin D status.

Even if the biomarkers of vitamin D were faithfully responsive to underlying status, a reliable analytical technology that is both precise and accurate for measurement would have to be available. Dr Bruce Hollis reviewed the topic from the point of view of analytical chemistry and did not paint a particularly rosy picture. At the extreme cutting edge of analytical capacity with high-precision liquid chromatography, up to eight metabolites from both the vitamin D₃ (cholecalciferol) and vitamin D₂ (ergocalciferol) series could be analyzed. However, this meticulous methodology is neither practical nor affordable for routine assessment of patients or populations.

Methods with rapid preparation of materials and short analytical times are the most practical. For this, the options are liquid-chromatography/mass spectroscopy, radioimmunoassay (RIA), and chemiluminescence. An intrinsic disadvantage of the RIA is the need for the disposal of radionuclide materials.

In terms of absolute agreement across methods and quantitative concentration, quality control comparisons provide disquieting results. On the one hand, different labs using the same technique get closely comparable values for common samples. On the other hand, using the different array of methods and the same sample in the same laboratory, assay results can differ substantially. Consistency within laboratories and within specific measures is important for any clinical or research application.

The National Institute of Standards and Technology (NIST) in the United States is set to release standard reference materials for vitamin D assays, sometime during 2008. A prudent conclusion is that, for the foreseeable future, great caution should be applied in comparing absolute values from different analytical sites.

Analytical variability aside, a large number of the invited speakers endeavored to synthesize the information on whether or not specific clinical and functional outcomes in vitamin D nutrition were associated with a constant and predictable biomarker status. As summarized by a leading pediatrician speaker, there is no firm circulating 25(OH)D cut-off level seen universally across cases of pediatric rickets. Biopsy-confirmed rickets has been diagnosed in children with vitamin D levels >25 nmol/L. A series of functional indicators, including bone mineralization and bone density, parathy-
NIH Vitamin D Conference

In the Gambians, maintenance of a high 25(OH)D concentration (~90 nmol/L), and high 1,25 dihydroxy D levels twice that of the British in summer), they have very low calcium intakes (300 mg/d). Gambians have a very low fracture risk and there is no association of PTH and 25(OH)D.

An obvious common component of the paradox is that the high PTH environment, as a consequence of low calcium intakes, does not demineralize bone in either setting or ethnicity. Evolutionary forces potentially explain some of these discrepancies with the “conventional” western experiences. However, it was a fitting caution to those who would extrapolate the available consensus findings as universally applicable to all humankind. Moreover, this exchange of geographical insights provides a perspective to question the universal nature of recommendations for dietary calcium, as well.

Paradoxes are not restricted to developing nations. Dr John Aloia, head of the departement at the Boston University School of Medicine, discussed the so-called African-American paradox in relationship to vitamin D status and bone health. Simply stated: “Although African-Americans have lower levels of 25(OH)D, they have fewer osteoporotic fractures.” Studies consistently show greater bone density in blacks compared to whites and Asians from childhood onward. The best explanation for this paradoxical situation is to be found in protective factors other than vitamin D against osteoporosis, including a more efficient calcium economy.

Intake of vitamin D from the diet

We know less than we might about the contribution of diet to overall vitamin D nutriture as food table values have taken a long time to be developed. Dr Joanne Holden discussed the evolution of the provisional food table values of the USDA for vitamin D in foods and dietary supplements. She outlined the elements of the ongoing update. Only a limited number of foods were analyzed, including fin-fish and shellfish, for their natural content of vitamin D, and fortified items, including milk, American sliced cheese, fortified margarines and spreads, as well as ready-to-eat cereals, orange juice and yoghurt. There is considerable sample to sample variability of vitamin D in foods as shown by the numerous studies on fortified milk samples, in which only a fraction fall into the specified range of vitamin content. An interesting vignette that escape most in the nutrition field is that the metabolized form (precursor hormone) of vitamin D [25(OH)D] also forms part of the human diet. This occurs in the visceral organs of marine fauna. When provisional values for vitamin D are applied in surveys from actual populations, only a limited number of individuals consume the normative (5 µg) exclusively from dietary sources. Getting any more to compensate for the demands in aging is truly a formidable challenge.

Dr Barbara Gilchrest is Professor of Dermatology and head of the departement at the Boston University School of Medicine.
Vitamin D status implications of lactation

The amount of vitamin D in human milk, and the recommendations of managing infant feeding came into sharp relief in the discussion. As a generic consequence of the lower vitamin D status in the black population, African-American women have lower vitamin levels in their milk, which would act synergistically with the child’s skin pigmentation to place the infant of dark complexion at risk. Formerly, black women had low breastfeeding rates, but recent lactation promotion among low-income women has managed to increase their breastfeeding practices. Furthermore, it is a standing recommendation within the clinical pediatric community in the US and Canada that medicinal vitamin D supplement drops be given to infants of all races. It was a consensus among the numerous practitioners in attendance that the prescription of supplements is widespread, if not universal, in North American private practice pediatrics and managed care settings. However, for low-income women, there is limited encouragement and no financing. Since the drops were viewed as a medicine, not a nutrient, the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) was proscribed from distributing vitamin D.

Another view voiced by the pediatrician community was the prudence, for such northern and temperate regions, of adhering to the WHO breastfeeding recommendations of exclusivity for six months, suggesting that introduction of fortified complementary foods between four to six months was much more appropriate. This was one of the fervent, policy-related discussions that arose over the course of the two days.

Vitamin D status and protection from chronic disease

A number of important issues affecting the public’s health were discussed in various sessions. Epidemiological evidence in populations, often supported by mechanistic studies in animals or in vitro systems, is emerging that supports the protective effect of superior vitamin D status on hypertension; osteoarthritis; type II diabetes; periodontal disease; sarcopenia and various cancers. In utero programming in response to the vitamin D status of the mother may influence the offspring’s risk or resistance to type I diabetes in early life or multiple sclerosis in later life.

Multiple sclerosis is one disease (prostate cancer is another) in which the south-to-north gradient in decreasing solar ultraviolet irradiation defines an increased risk of disease incidence. Dr Cindy Davis, of the National Cancer Institute, reported on the findings of an earlier meeting on the NIH campus on the topic of vitamin D and cancer. The proceedings of this event were published a month earlier in a supplement in Nutrition Reviews in August 2007.

Maximizing human vitamin D status in practice

In the waning hours of the conference, attention turned to the issues of Questions 4 and 5 for the evidence-based reviews, and Question 5 for discussion (Box 1). These centered around getting more vitamin D and the need and rationale to getting more of the vitamin. Recommendations are required for prudent amounts of sun exposure to maximize the circulating carrying capacity for 25(OH)D. Fishermen and beach lifeguards maintain what is considered optimal vitamin D levels; obviously, different durations of sun exposure would be needed, depending on skin color and age, to achieve such amounts in the blood, and it would only be possible in northern latitudes during the summer months.

Prof. Barbara Gilchrest, a distinguished dermatologist, proposed that attempting to maximize vitamin D status from solar exposure was not a quest to be recommended for anyone. She recounted the muta-
Genic effects of solar radiation which are responsible for both the skin aging and skin cancers. She suggested for individuals of all races to use sun-screen creams when going into sunlight, for them to rely on dietary supplements containing the contemporary Adequate Intake levels for vitamin D protection.

This was an appropriate lead-in to the discussion of what contemporary science would suggest to be safe and adequate levels of dietary vitamin D. The Adequate Intake levels for recommended daily intakes of dietary vitamin D from the US-Canada Dietary Reference Intakes are 5 µg (200 IU) from birth to 50 years, including during pregnancy and lactation. It rises to 10 µg between 51 and 70 years, and to 15 µg into the 8th decade and beyond.

Given the litany of aforementioned diseases and conditions whose risk could be reduced by vitamin D, both invited speakers and members of the audience offered the opinion that the current levels are low. This led to an examination of what are considered to be the Upper Tolerable Intakes. These are 25 µg (1,000 IU) for infants and 50 µg (2,000 IU) for all individuals over one year of age. Advocates for a revision of the currently recommended dietary vitamin D levels seek intakes that are greater than the current Upper Limits (UL); so their first burden is to show that chronic ingestion of superior amounts are safe as well as potentially beneficial.

A syndrome of chronic hypervitaminosis D characterized by hypercalcemia, hyperphosphatemia, calcification of soft tissues, and excessive diuresis of water has been reported with the excessive intake of cod liver oil or vitamin D supplements. It seems to be explained by the release from binding of the more polar vitamin D metabolites in the blood stream.

Dr. Reinhold Vieth advocated the position that a prudent intake of vitamin D may be several fold higher than the 2,000 IU UL for adults. He first justified the proposition for an UL that is well above the current estimate. One argument holds that the maximal carrying circulating capacity among lifeguards, for example, with tanning sun-exposure throughout the summer of about 180 nmol/L is achieved at an oral intake of 250 µg (10,000 IU). He also pointed to a number of medical conditions in which chronic high-dose vitamin D has been used in therapy. One example is a dose-response study in multiple sclerosis patients, who consumed doses from 100 to 1,000 µg of vitamin D. It was only at the highest dose that any increase above normal calcium levels was observed.

Dr Vieth is part of the authorship of a commentary, which concluded: “Collectively, the absence of toxicity in trials involving normal adults using vitamin D dosages at and above the dosage of 250 µg/day (10,000 IU vitamin D₃) supports the confident selection of this value as the UL.”

Conclusion

Two days of intense, programmed presentations and discussions brought both heat and light to the imposing topic of vitamin D and health. The systematic literature searches presented failed to convincingly resolve many of the issues posed for the evidence-based reviews, clearly indicating the need for continuing research. The focus of nutritional status assessment remained on the intestinal-bone-parathyroid axis of classical concern. Universal and generalizable cut-offs for 25(OH)D in relation to pathological deficiency states or vitamin D-responsive conditions cannot presently be agreed upon. Geographic and ethnic factors may forever impede such a consensus, even when greater inter-laboratory standardization of quantitative measures is achieved.

It seemed, however, that the core agenda of the conveners and the central interests of the audience at the vitamin D update meeting were somewhat divergent. The latter were looking “beyond bone” toward the promising findings of an association of “optimal” or “maximal” vitamin D status with decreased chronic disease risk across a range of ailments. In fact, it is the emergent hope for greater public health achievements beyond better bone health that will drive the enthusiasm and give direction to the next generation of vitamin D research.
Venkatesh Mannar is President of The Micronutrient Initiative (MI), a not-for-profit organization that supports some of the most vulnerable people in the world by helping to ensure that they receive adequate supplies of the micronutrients they need for a healthy diet. In the third of our series, A Day in the Life, Venkatesh Mannar talks with SIGHT AND LIFE about what he describes as the ideal job for him.

Venkatesh Mannar (VM): My prime responsibilities are to set the overall vision and direction of MI, through advocacy and partnering with key organizations around the world, as well as overseeing the implementation of all our projects and ensuring that our work meets the high standards we expect of ourselves.

SAL: How long have you been in this role?

VM: Since 1994. I was born in India and spent the first forty years of my life there. I started my working life as a chemical engineer and food technologist. An involvement in my family business in the manufacture of salt during the 1970s and ’80s got me interested in the iodization of salt, and it was this that made me aware of the work of UNICEF in the field of food fortification. I subsequently moved to Canada to take up my present role. So I’ve been working in the field of micronutrients and food fortification for about thirty years in total.

SAL: You have a global portfolio and have to interact with people from all over the world. Does everyone understand the term ‘micronutrients’ in your experience?

VM: That’s a very good question. Very often they don’t. But in my experience, even the poorest and least educated sections of society understand the terms ‘vitamins’ and ‘minerals.’ They associate vitamins automatically with health and, when I talk in terms of vitamins and minerals, they understand what I mean.

SAL: Who are the beneficiaries of your work?

VM: We exist to serve populations around the world whose diets are deficient in micronutrients. We presently reach approximately 500 million people worldwide, most of them women and children. From these regional offices, we operate our country offices around the world. Overall, we employ approximately 100 people full-time, worldwide, as well as an additional hundred consultants, some of whom work part-time and some full-time.

SAL: Can you tell us something about where you work and the people you work with?

VM: MI is headquartered in Ottawa. My office is on the tenth floor, and I’m fortunate enough to enjoy spectacular views over downtown Ottawa as I mentally engage myself with our work in distant parts of the world. There are thirty of us working for MI in this building. We also have regional offices in Johannesburg in Africa and Delhi in India. From these regional offices, we operate our country offices around the world. Overall, we employ approximately 100 people full-time, worldwide, as well as an additional hundred consultants, some of whom work part-time and some full-time.
though I always try to remind people that our objective is in fact very simple: to get vitamins and minerals to the people who really need them.

**SAL:** Do you have such a thing as a normal working day?

**VM:** I think I actually have three types of normal working day! The first is a day like today, when I’m in my office here in Ottawa, spending my time in meetings, planning activities, and making phone calls. But something like 30–35% of my time is spent travelling, and when I’m travelling, I have two typical sorts of day. The first is when I’m travelling to cities in the developed world to meet and talk with partner agencies or attend international meetings, for instance. The second is when I’m out in the field in developing countries, helping to deliver programs on the ground. These trips involve seeing the conditions in the field firsthand, meeting with government partners, the press, and so on, and are extremely busy.

**SAL:** What are the things you look forward to in your working day?

**VM:** The thing I really look forward to about my work is the fact that every day is different. So many new discoveries are constantly being made, and so much new information is being generated. These new improvements help me plan in concrete terms how we can realize our goals. They also keep me upbeat about my job. In fact, I can honestly say about myself that I haven’t been able to imagine a better job for me. I’m very happy with what I do.

**SAL:** Which aspect of your work is most important to you?

**VM:** For me, the most important aspect is the technical and managerial side of my role. We’re working on innovations and new initiatives all the time and these efforts require considerable oversight. It’s also very important to maintain good relationships with counterparts in partner organizations. We must never forget that our objective is to serve the poor of the world and we have to make sure that we serve them regardless of who gets the credit.

**VM:** I think if I could change anything about my job, what would that be?

**SAL:** If you could change anything about your job, what would that be?

**VM:** I think if I could change anything, I would try to travel less. Long-haul travel is extremely exhausting. Having said that, I know just how important it is to travel in my role. Just last week, I was in Ethiopia and being on the ground there reminded me of how essential it is for me to make these trips on a regular basis.

**SAL:** Returning to the topic of micronutrients, how important is the quality of the micronutrients supplied to populations in need?

**VM:** It’s of absolute importance. The micronutrients we help to supply to populations in need have to be up to standard and, if they’re not, they can be virtually useless. That means that the utmost attention has to be paid to the quality of the micronutrients being supplied, the ingredient ratios, and the dosing schedules as well.

**SAL:** Is it possible to express the cost-benefit ratio of your interventions around the world – in other words, to put an economic value on the work you do?

**VM:** There are various metrics for measuring what we do. To sell our ideas, we have to be able to convince hard-headed economists and policy makers, so it’s important to be able to quantify these things. Statistics vary, but one can confidently say that the cost of delivering micronutrients is miniscule in relation to the benefits that people derive from them. I would say that the cost-benefit ratio is in the order of 1:100. In fact, the World Bank remarked during the 1990s that micronutrients were “the bargain of the century.” I believe they are the bargain of the 21st century as well!

**SAL:** What needs to be done in your view on a global and country scale to achieve our common goals in the fight against malnutrition?

**VM:** The most important thing is to apply and scale up what we already know, ensuring that those in need get what they require on a self-sustaining basis. Micronutrients have to be part of a sustainable supply chain. I would very much emphasize that we need to focus on action and on scaling-up. We don’t need more research to help us do this – we know enough already. When I’m in the developing world, I often cite the example of Canada. Canadians had a number of nutritional problems fifty years ago when the Government set about addressing issues of nutrition in a systematic way, to the great benefit of the country’s population. Thanks to those efforts, the levels of nutritional deficiencies today are extremely low. If Canada has been able to do this, other countries can do so too.

**SAL:** Turning our attention now to the humanitarian initiative SIGHT AND LIFE, what does it mean to you?
VM: I’ve known SIGHT AND LIFE ever since I first joined MI. I have great respect for its work. SIGHT AND LIFE draws together top researchers from around the world and makes their findings available worldwide. Long may its excellent work continue.

SAL: How about our magazine? What do you enjoy about it, and are there ways in which it could be improved?

VM: I read SIGHT AND LIFE Magazine regularly and I really enjoy it. What I value about it is that it informs me about things that I don’t read elsewhere even though I update myself regularly regarding developments in this field and constantly strive to stay abreast of new developments. The reports in SIGHT AND LIFE Magazine are of high technical quality and scientific veracity, which I greatly value. The magazine also has a good mix of scientific information and programmatic application. I value this balance and very much hope that it will be maintained.

SAL: What about your private life? What do you do to switch off from work?

VM: I think it’s very important to have a life outside work. While I enjoy my work, I’m certainly not a workaholic, and I think it’s important to maintain a good balance in order to be able to do your job well. I enjoy both western and Indian classical music, photography, skiing, tennis and gardening.

SAL: Do you have a final message for our readers?

VM: I do. We are on the home stretch in our endeavor to eliminate micronutrient deficiencies by 2015. The coming decade will be the most exciting period in making this happen. What I would personally like to see is more young people getting involved. It would be great if SIGHT AND LIFE could help draw in more of the younger generation to work in the area of nutrition and reach the poorest and neediest people in the world.

Interview by Jonathan Steffen

The Micronutrient Initiative (MI) – Vision, Purpose and Mission

**Vision**
Our vision is of a world free of hidden hunger.

**Purpose**
MI is dedicated to ensuring that the world’s most vulnerable – especially women and children – in developing countries get the vitamins and minerals they need to survive and thrive.

**Mission**
To develop, implement and monitor innovative, cost-effective and sustainable solutions for hidden hunger, in partnership with others.

We believe that:
- Children have the right to a healthy start in life and should grow up free from the preventable impairment of hidden hunger.
- Women have the right to the vitamins and minerals that will provide for their full economic and social participation in society.
- Working in partnership with governments, the private sector, and civil society organizations is essential to success.
- Collectively, we have the ability to implement existing and affordable solutions for hidden hunger – to the benefit of a full third of the world’s population.

For more information, please visit http://www.micronutrient.org
Multiple Micronutrients — the Way Forward

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In 2007, SIGHT AND LIFE’s literature digest shifted from a predominant focus on vitamin A to a wider coverage of all the micronutrients. This broadening of focus was not because vitamin A is no longer important but because we now recognize that vitamin A deficiency does not occur alone.

Malnutrition has multifactorial origins and, in general, people who lack vitamin A also lack food both in quantity and quality. A poor-quality diet is very likely to be deficient in not just one but several nutrients and micronutrients. Hence, dietary intervention with just one micronutrient may not only be short-sighted but potentially harmful. Supplying just one micronutrient may only replenish one set of needs while exposing another. However, too much of one nutrient could also antagonize the absorption of another and worsen an already fragile nutritional situation.

Broadening the scope of the literature digest, however, was not without its difficulties. It very quickly became apparent that, while 30 to 40 abstracts might cover the recent vitamin A literature in one issue, a maximum of 40 abstracts would not adequately cover the literature on multiple micronutrients. Even a strict selection of the most interesting papers resulted in a backlog of worthwhile papers that accumulated for the future issues. This was happening even within the space of one year and led to the consideration of an alternative approach.

We decided to accept that it was not going to be possible to effectively cover the recent literature on multiple micronutrients in a few pages of SIGHT AND LIFE. Shortening the abstracts further than had previously been done risked losing too much information to pique readers’ interest and leave little more than headings.

We therefore decided to change the Recent Literature section completely. For the foreseeable future, recent literature will be abstracted and uploaded onto the SIGHT AND LIFE website. We realize this might disappoint readers who browse through the abstracts during idle moments while travelling in a taxi or train, or waiting for the arrival of a visitor. However, we felt that, as the literature digest could never be fully comprehensive, browsing for literature of interest is better left for more purposeful searching using a computer.

These days, we assume, most readers have access to the World Wide Web for at least some time during the day. Furthermore, shifting the abstracts to our website allows all recent papers to be included and prevent a backlog developing. And last but not least, there is something to be said for shifting information from offline (trees) to online media (energy that can be used more efficiently or sourced renewably) in light of important environmental concerns.

Nonetheless, we believe there is still a role for a literature digest in the magazine for the foreseeable future, though, instead of attempting to cover everything, we would focus on specific emerging issues. This might mean highlighting a specific aspect of micronutrient metabolism in a review of a group of papers, or a single paper or a journal supplement with potentially important implications.
In this issue, some recent concerns about vitamin D are considered. Vitamin D is conventionally associated with calcium metabolism and the development of healthy bones. Several years ago, however, vitamin D receptors were found to be present on cells from many other tissues than bone, including immune cells. If vitamin D has a role in immunity or the prevention of cancer, this is particularly important as poor vitamin D status is present in both the developed and developing world, in segments of the population who have inadequate exposure to sunlight.

Thus, the literature digest continues to be a staple in SIGHT AND LIFE, but – from this issue on – presented as one or more short reviews on current topics of interest in the micronutrient field. We hope you will continue to quench your knowledge needs in our pages and the magazine will continue to feature in your offices, waiting rooms and briefcase for all to browse and learn of developments in the field of micronutrients throughout the world.

Current Issues surrounding Vitamin D

Introduction

In a number of papers abstracted in Issues 2 and 3 of SIGHT AND LIFE Magazine in 2007, vitamin D was associated with protection against bacterial antigens and a lower risk of different cancers. These were just some of the many papers that have been published in recent years on properties of vitamin D completely different from the skeletal function with which it is more commonly associated.

The implications of these observations are enormous. Defending against disease and reducing the risk of cancer are essential features for a long and healthy life. If it can be established that vitamin D status has causal links with disease and cancer, then this work is highly relevant for each and every one of us. The risk of chronic diseases and internal cancers increases as we get older and epidemiological evidence suggests the mortality risks for these cancers and other chronic diseases increase with growing latitude in the USA and other countries.

Previously, adequacy was defined in terms of skeletal requirements and the maintenance of bone density. But if disease and cancer risk can be modified by improved vitamin D status, should the threshold for adequacy be raised? Sunlight is a highly efficient stimulant of endogenous vitamin D synthesis. However, recommending increased exposure may conflict with public health policy on protection from skin cancer. ‘Sun blockers’ may reduce the risk of cutaneous malignant melanoma but over-use may be counterproductive for vitamin D status. These are some of the issues discussed in this report.

Vitamin D physiology

The main metabolic pathway in vitamin D metabolism was resolved by the 1970s. The action of ultra-violet irradiation in sunlight (UV-B, 250–310 nm) converts 7-dehydrocholesterol in our skin cells to cholecalciferol, and this is metabolized to 25-hydroxy-cholecalciferol (25OHD) in the liver and released into the blood, where it is coupled with a binding protein. Most of the vitamin D in the body is present as 25OHD and the concentration present in plasma is used to indicate vitamin D status. Mostly, 25OHD is present as endogenously-synthesized 25OHD, but 25OHD may also be present.

Vitamin D (ergocalciferol or ergosterol) is man-made from plant sources and is used in addition to vitamin D3 in supplements. The classical role of vitamin D in calcium homeostasis and bone metabolism has long been recognized to be due to the production of 1,25-dihydroxyvitamin D (calcitriol) by a further hydroxylation of 25OHD by 1α-hydroxylase activity in the proximal tubule in the kidney.

Calcitriol is the physiologically active form of vitamin D and maintains normal blood levels of calcium and phosphate and these in turn are needed for normal mineralization of bone, muscle contraction, nerve conduction and general cellular functions in all body cells. The
active form of vitamin D regulates the transcription of a number of vitamin D-dependent genes coding for calcium-transporting and bone-matrix proteins. The function of calcitriol has long been recognized to be the result of a stereo-specific interaction between calcitriol and intracellular receptor proteins. That is calcitriol functions like a steroid hormone. However, the discovery of the receptor proteins for calcitriol led to previously unsuspected actions of vitamin D.

Receptors for calcitriol were discovered in neoplastic cell lines, and the effect of calcitriol on these cells was found to be anti-proliferative and to promote differentiation. Subsequently, receptors for calcitriol were found on many cells in the haematolymphopoietic system. Furthermore, calcitriol can induce maturation of monocytes to macrophages. The kidney is the main source of calcitriol in the body but vitamin D 1α-hydroxylase activity has also been shown to be present in other tissues, for example, mature monocytes and macrophages, activated T and B lymphocytes.

Reichel and colleagues showed that lipopolysaccharide-stimulation of normal human alveolar macrophages was necessary in order for them to metabolize 25OHD₃, indicating that the presence of foreign antigens (i.e. disease) in the body will trigger the production of calcitriol in the macrophage. Calcitriol displays immunomodulatory properties both in vivo and in vitro. Calcitriol (in company with retinoic acid, the active form of vitamin A) significantly inhibited the production of pro-inflammatory cytokines TNF and IL-6. That is, the therapeutic effect of vitamin D and retinoic acid on inflammatory skin diseases are partially due to the inhibitory effect on polymorphonuclear blood cell cytokine production.

In addition, inhibition of the pro-inflammatory response by vitamin D diminishes the turnover of leukocytes. Leukocyte telomere length (LTL) is a predictor of aging-related disease and decreases with each cell cycle and inflammation. An analysis of serum 25OHD concentrations in 2,160 women (aged 18–79 years) recently found the difference between the lowest and highest vitamin D concentrations to be equivalent to five years of telomeric aging, underscoring the potential beneficial effects of vitamin D on aging and age-related diseases.

**Vitamin D equivalency**

Since the 1930s, it has been assumed that vitamins D₂ and D₃ are handled identically by the body but two recent papers have questioned this assumption. Trang et al fed 100 µg of the two vitamins for 14 days and found the response to D₃ was much greater than that to D₂. Armas et al gave a single dose of 1.25 mg and showed that, although the response over the first three days was the same, the eventual response was almost 10 times greater for D₃ than D₂ when followed for 14 days.

However, the most recent feeding study to examine the equivalency of the two forms of vitamin D was longer than that of either of the above studies and found identical serum 25OHD responses. Subjects (aged 18–84 years) were randomly assigned to receive a placebo, 1,000 IU (25 µg) of one or the other form of vitamin D, or 500 IU of both forms for 11 weeks at the end of winter. There were no differences in 25OHD concentrations at baseline and concentrations in all three treatment groups increased from ~42 to 70 nmol/L while there was no change in those receiving the placebo. Holick et al fed for 11 weeks and the longer time of supplementation may allow responses to the two forms of vitamin D to equalize. The methodology was specific for the individual isomers in these studies.

Others nevertheless contest the view that the two forms of vitamin D are metabolically equivalent and maintain that the plasma response to vitamin D₂ is not as great as that from vitamin D₃. The workers point to evidence suggesting that vitamin D₂ does not bind as efficiently to the liver 25-hydroxy-lase enzyme as vitamin D₃ and that 25OHD₂ may not attach to the plasma-binding protein as efficiently as 25OHD₃. In addition, the authors suggest that the plasma 25OHD₂ response to feeding vitamin D₂ is greater in young men than that in older men. Unfortunately, a factor not considered in the latter paper was the methodology used in the studies on vitamin D₂ that they examined. Recent work has shown that at least one commonly used method of measuring 25OHD underestimates 25OHD₂ and this may well alter the interpretation of some of the older studies.
The methodology used to assess serum 25OHD concentrations has recently been under scrutiny. The International Vitamin D Quality Assurance Scheme (DEQAS) has monitored the performance of 25OHD assays since 1989 and has over 100 registered participants in 18 countries. Six methods are currently in use: Two radio-immuno assays (RIA) that are used by most participants and ELISA, competitive-protein binding, liquid chromatography, and the Nichols automated chemiluminescence assays. Accuracy, as defined by the mean percentage deviation from the all-laboratory trimmed mean, was <7% for all methods, except the Nichols assay (~31%), in the measurement of 25OHD3. Unfortunately, one RIA and the Nichols assay did not detect 25OHD2 satisfactorily and all assays, except liquid or gas chromatography, overestimated 25OHD if any 24,25 diOH-vitamin D was present. Generally speaking, the interference from the 24,25 diOH-vitamin D metabolite is small but, in countries where dietary supplementation with vitamin D3 is common, the method of measurement of 25OHD is critical.

**Physiological adequacy**

In general, solar radiation is the major source of vitamin D in humans and 25OHD3 is the major metabolite. Some foods (e.g. dairy foods, eggs and fatty fish) naturally contain vitamin D3 but only in small amounts. Hence, the concentration of plasma 25OHD in the absence of supplements will usually be directly related to sunlight exposure. Where vitamin D2 supplements are common, as in the USA, a variable amount of 25OHD2 will also be present in plasma but, unless specified otherwise in the rest of this paper, the abbreviation 25OHD will be assumed to include both forms of vitamin D.

Because the serum 25OHD concentration depends, in most people, on solar radiation, there are often pronounced seasonal changes, with the highest concentrations in late summer and the lowest concentrations in early spring. There is no specific store of 25OHD but because of its fat-solubility, it is probably mostly present in adipose tissue. Winter-time concentrations of serum 25OHD measured in 824 elderly people from 11 European countries found 36% men and 47% women had 25OHD concentrations below 30 nmol/L. The lowest mean 25OHD concentrations were seen in southern European countries. The low 25OHD concentration could largely be explained by attitudes to sunlight exposure and factors of physical healthy status. Findings suggest that free-living elderly Europeans, regardless of geographic location, are substantially at risk of inadequate vitamin D status during winter.

**Important effects of vitamin D beyond bone health**

In the European study on elderly persons, a concentration of 30 nmol/L 25OHD was used as the threshold to define adequacy. The minimal concentration of 25OHD to ensure normal bone health, used by many committees to establish requirements for vitamin D, is 27 nmol/L, but this frequently rounded off to 30 nmol/L. At the other extreme, concentrations greater than 70–75 nmol/L 25OHD have been used to define adequacy and values between 30 and 70 as ‘insufficient’. The 5th to 95th centiles for 25OHD concentrations in subjects of both sexes and all ages and ethnicities in the NHANES III survey were 27 and 115 nmol/L. Although these values were obtained from an American population, similar concentration ranges have been found in other studies where supplementation was not as common. On the basis of these data, an adequacy threshold of 70 nmol/L suggests that vitamin D status in more than half the population is insufficient. Are there any health justifications to raise the adequacy threshold above 30 nmol/L?

**Bone health**

Several recent studies have attempted to relate serum 25OHD concentrations to health risks associated with falls and fractures in the elderly. In a large study of post-menopausal women who were part of the Women’s Health Initiative clinical trial, women (aged 50–79 years) received 1 g calcium and 10 µg vitamin D3 or a placebo. In a follow-up over seven years, vitamin D supplementation resulted in a small but significant increase in hip bone density, but did not significantly reduce hip fracture. There was also no protective effect of vitamin D on non-vertebral fractures (hip, wrist and ankle) and on falls when 7.5 mg vitamin D3 or placebo was injected intra-muscular (im) every autumn, over three years, in ~9,500 men and women aged over 75 years. However, workers in Australia who gave 25 µg vitamin D3/d for one year to women (mean age 77 years) reported a 23% reduction in risk of falls in both winter and spring, and suggested that the plasma concentration of 25OHD to prevent falls should be 54 nmol/L. Of relevance to the above studies, Finnish workers who gave different doses (0, 5, 10 and 20 µg) of vitamin D3 for 12 weeks to elderly...
women (aged 65 to 85 years) concluded that 15 µg/d maintained serum 25OHD concentrations at around 40–55 nmol/L during the winter.30 The results in the above studies can tentatively be interpreted as suggesting that skeletal problems in elderly people may be reduced by maintaining plasma 25OHD concentrations at around 50 nmol/L, and that requires daily supplements of around 15 µg of vitamin D. An annual injection of a depot of vitamin D (equivalent to 20 µg/day) was not protective.

Emerging health effects

Cardiovascular system

A growing body of evidence suggests that vitamin D deficiency may adversely affect the cardiovascular system because vitamin D receptors are widely distributed in vascular smooth muscle, endothelium, and cardiomyocytes.31 In a longitudinal study of subjects (mean age 55 years) without prior cardiovascular disease, workers reported a 60% higher risk (p = 0.011) of incident cardiovascular disease over the subsequent 5.4 years in persons with plasma 25OHD concentrations <37.5 nmol/L, compared to those with higher concentrations.31 The risk was 80% greater in those with baseline concentrations <25 nmol/L.

Further evidence of possible benefits from vitamin D in preventing heart disease were obtained in a double-blind, placebo-controlled intervention study where 93 patients with heart failure were given 50 µg vitamin D3 per day for 9 months together with 500 mg calcium/day.32 Mean plasma 25OHD concentration was 27 nmol/L at baseline, rose to 103 nmol/L in the D+ group, and fell by 9 nmol/L in the D- group. The authors reported that vitamin D treatment significantly reduced parathyroid hormone concentrations and also had anti-inflammatory effects. There was an increase in the anti-inflammatory cytokine IL-10 and no change in the pro-inflammatory cytokine TNF in the D+ group while TNF concentrations increased in the controls. The two studies suggest that vitamin D status may have important implications in the etiology of cardiovascular disease and that concentrations of 25OHD above 37.5 nmol/L are desirable to reduce the risk of heart disease.

Cancer

The first demonstration of calcitriol-mediated inhibitory action on tumor cell growth was demonstrated in 1981 using a melanoma cell line.33 Subsequently, epidemiological evidence suggested that mortality rates of carcinomas of the colon, breast and prostate tended to be highest in areas in the USA (and other parts of the world) where sunlight exposure is low.34–36 In a prospective study of colon cancer in 25,620 volunteers, 34 cases diagnosed between 1975 and 1983 were matched with 75 controls by age, race, sex, and month blood was taken. The risk of colon cancer was 75% and 80% lower in the 3rd and 4th quintiles of the 25OHD distribution, and the workers concluded that the risk of colon cancer was decreased three-fold in people with 25OHD concentrations of 50 nmol/L and more.37

More recently a case-control study of post-menopausal breast cancer in Germany found similar results for 25OHD concentrations and breast cancer.24 Serum 25OHD concentrations were significantly inversely associated with the cancer risk. Compared with the lowest category <30 nmol/L, there were progressively between 43 to 69% lower risks of breast cancer with increasing concentrations of serum 25OHD up to the highest category of ≥75 nmol/L. The inverse association was stronger at concentrations of 25OHD <50 nmol/L, suggesting that, at concentrations above 50 nmol/L, little further benefit from vitamin D against breast cancer can be achieved and that this should be the target concentration in the blood. It was interesting that the effects of 25OHD on cancer risk were less obvious in those on hormone replacement therapy (HRT). This may be because elevated estrogen concentrations are associated with higher concentrations of 25OHD38 and retinol39 for reasons that are not immediately obvious.

Finally, in a recent paper on the health benefits and risks involving vitamin D or skin cancer from increased sun exposure, Moan et al discuss the controversy as to whether increased sun exposure prolongs or shortens lifetime expectancy, results in fewer or more cancer deaths, and generally leads to health benefits or risks.4 It is generally accepted that cutaneous malignant melanoma (CMM) is the main negative consequence of sun exposure but the relationship is not straightforward as CMM frequently develops in shaded areas of the body4 and calcitriol, itself, inhibits melanoma cell growth in vitro.33 Thus, the etiology of CMM needs to be better understood and the authors maintain, from experiments using controlled UV exposure, that the endogenous production of 25OHD from sunlight is difficult to match even from vitamin D-supplemented dietary sources. The authors therefore conclude that, although sun exposure is involved in the etiology of CMM, increased sun exposure may lead to improved prognosis of internal cancers and possibly result in more health benefits than adverse effects.
Critical Review on Vitamin D

Conclusion

In conclusion, in vitro studies have clearly shown that vitamin D has additional health-promoting roles beyond those of skeletal health. The risks of mortality from chronic disease and internal cancers appear to be inversely related to vitamin D status. Epidemiological studies suggest that concentrations of serum 25(OH)D above 50 nmol/L are necessary for optimal health benefits and mean concentrations in many elderly people are below this. How the additional vitamin D should be obtained is a matter of ongoing debate. Solar irradiation is an efficient source of endogenously-synthesized vitamin D3, but would increased exposure increase the risk of skin cancer? If we rely on dietary supplements to increase status, is vitamin D2 as efficient as D3? Lastly, problems in the measurement of serum 25(OH)D concentrations have recently been revealed and these must be resolved to give greater confidence in reported results.

References

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Critical Review on Vitamin D


Thank you for the many good wishes we received for 2008.
News

SIGHT AND LIFE takes action on Nutritional Anemia

November 29, 2007, was an important milestone for SIGHT AND LIFE as the initiative hosted the first-ever Anemia Action Day at its headquarters in Kaiseraugst, Switzerland.

Open to employees from DSM Nutritional Products’ Kaiseraugst and Birsfelden sites, the event was also attended by a range of guests, including Dr Werner Heinecke, Director of Win=Win, an agency that advises multinational corporations on sustainable globalization, and Mr Max Heller, Mayor of Kaiseraugst.

Public health scourge

As Dr Klaus Kraemer, Secretary General of SIGHT AND LIFE, explained: “We have learned a lot about nutritional anemia and identified that it is a problem not only for the developing world but also for the developed. Many people associate anemia solely with iron deficiency, but the condition also involves deficiencies of other micronutrients.

“Our first Anemia Action Day was an important opportunity to encourage employees of DSM Nutritional Products not only to learn more about SIGHT AND LIFE but also to engage with the problems presented by this global public health scourge.”

Hidden hunger

Worldwide, a total of 818 million women and under-five children are affected by nutritional anemia. Approximately 1 million die every year and some 200 million children fail to reach their cognitive, motor, and social and emotional potential because of micronutrient deficiencies and inadequate stimulation. No fewer than two billion people worldwide suffer from ‘hidden hunger’ – a condition whereby food intake is sufficient in caloric terms but lacking in micronutrients. According to the World Bank, the cost of child malnutrition is as much as 2–3% of annual GDP in some developing countries.

Hands-on engagement

The Anemia Action Day offered many avenues for exploring the nature and the implications of nutritional anemia. An extensive array of specialist literature and informative posters was supplemented by a documentary film about SIGHT AND LIFE. There
were also lectures by leading specialists in micronutrient science. Dr Ines Egli, of the Zurich-based Swiss Federal Institute of Technology, talked about the global prevalence of anemia and potential interventions against it, while her colleague, Dr Stefan Storcksdieck, elaborated on the interactions of micronutrients in the etiology of anemia.

There was plenty of opportunity for more hands-on engagement with the topic. Visitors were invited to participate in an anemia fact quiz and to have their blood hemoglobin level assessed. Nutritionists and a company doctor on hand to advise them on redressing possible micronutrient imbalances, and a range of nutritious foods and beverages stimulated the appetite for a deeper understanding of the relationship between micronutrient intake and physical well-being.

The event was filmed as part of a documentary that will be made available to the wider employee community of DSM this year.

Employee commitment

Stephan Tanda, the DSM managing board member responsible for the company’s Nutrition Cluster, commented: “SIGHT AND LIFE is an important driver of DSM's corporate social responsibility agenda and has a pivotal role to play in helping to turn scientific knowledge into humanitarian action where it is most needed.”

“With informative content and an engaging approach, the first Nutritional Anemia Action Day was an excellent example of the commitment of DSM’s employees to this endeavor. I hope that this will be the first of many such initiatives to be organized throughout the wider world of DSM.”
World Sight Day:
10-Day program of eye health events in Aurangabad, India

A 10-day program of community-based activities was initiated in the historical city of Aurangabad, Maharashtra, India, on World Sight Day (October 14), with the goal of facilitating information, education and communication on childhood blindness to children and their parents, as well as inciting the interest of the community in dealing with avoidable nutritional blindness.

The event received financial support from SIGHT AND LIFE and moral support from VISION 2020, as its executive director, the Hon. P.K.M. Swamy, and local officials, doctors, educators, and media representatives formed a committee to coordinate and run the activities smoothly.

The program included a drawing competition for school children on the theme of “Vitamin A for Healthy Eyes.” Over 400 students from various schools participated and 14 winners were selected for best posters.

Talks on the theme of childhood eye diseases and care were held in a number of schools, with a total of nearly 8,500 students participating in or otherwise attending the talks. A rally for school children was organized on October 15, at which the city’s police commissioner and other officials released balloons carrying VISION 2020 messages on the “right to sight”, “vitamin A for healthy eyes”, and other key themes of the World Sight Day events.

A special musical event was held on October 20, inaugurated by the former minister for Rural Development, the state program manager of the National Rural Health Mission, and other key officials, and covered by the national media. Prizes for the drawing competition were awarded at this event to the mothers of the winners as well as community leaders and other honorees.

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Global panel of economists and nutritionists calls access to good nutrition a human right

In keeping with our goal of bringing the world’s foremost thinkers together to bear on the “global nutrition crisis,” SIGHT AND LIFE has leveraged its resources, financial as well as – and perhaps more importantly – knowledge- and network-based, to sponsor and organize a landmark roundtable discussion involving thought leaders and practitioners from the global nutrition and economic communities.

In the future, will the rich, able to afford a diet optimized to their genetic makeup, become a super species, living substantially longer than the underprivileged, or will today’s society make access to adequate nutrition a global agenda and a basic human right?

These questions and others were addressed by nearly 50 nutrition, public health, food technology and eco-
Nomic thought leaders from 11 countries at a global roundtable discussion in Santa Barbara, in the US state of California, on March 12, 2008. Among the panel leading the discussions were two Nobel Laureates and several Medal of Science winners.

The ground-breaking event, on the theme Hidden Hunger: Socioeconomic and Scientific Challenges, was co-organized by SIGHT AND LIFE, the Oxygen Club of California (OCC), the Linus Pauling Institute, and the University of Southern California (USC) School of Pharmacy. SIGHT AND LIFE’s Secretary General, Dr. Klaus Kraemer, originated the idea for it together with Dr. Lester Packer, the world’s foremost antioxidants scientist.

The main purpose of the event was to advance a common agenda for the global community to address hidden hunger that would include the following strategies:

- Making possible the local production of high-quality foods containing all vitamins and minerals (micronutrients) in the countries that need them, while doing so in a culturally-friendly way and making use of locally-available staple foods.
- Scaling up food fortification so that more countries implement mandatory and voluntary fortification strategies.
- Making more use of multi-micronutrient powder that can be conveniently added at the point of use to locally-produced foods.

Dr Kraemer stated, “So far, we have primarily addressed non-governmental and governmental organizations as well as the United Nations community, but SIGHT AND LIFE encourages the nutrition industry to pick up these recommendations because there are plenty of business opportunities for quality products that are in need.”

Underlining the importance of creating an environment that supports the implementation of nutrition solutions, Dr Kraemer gave the example of the cyclone that struck Bangladesh in November 2007, when it took the government several months to approve a formulation for the multi-micronutrient powder donated by DSM to the World Food Programme.

“To avoid this in the future,” he said, “we need to help create legal frameworks in countries, defining what types of ingredients manufacturers can add to food, and in what quantities, plus quality assurance and enforcement measures for industry to comply with.”

Stephan Tanda, a member of the DSM Managing Board responsible for its Nutrition Cluster and a roundtable participant, added, “Malnutrition is a global crisis [that] stunts the lives and livelihood of more than two billion people worldwide.”

Noting a recent article in the scientific journal, The Lancet, that suggested providing young children with proper nutrition could boost their earning power as adults, Tanda continued, “We must determine how to sustainably provide proper nutrition to all who are mal-
nourished. As a leading provider of nutritional ingredients, DSM is well positioned to be part of the solution.”

Hidden hunger affects populations in rich and poor nations alike. In the USA, for example, despite the fortification of flour with iron and B vitamins, iron deficiency still affects 2.4 million children and is more severe among overweight children of low socioeconomic status. Millions of US citizens (11% of all households) are unable to buy nutritious food for economic reasons, according to the US Department of Agriculture (USDA). A Canadian study suggests that this translates into significant nutrient inadequacies among adults and adolescents. Similarly, a recent report from Mexico showed the simultaneous risk of overweight and stunting (short linear growth due to hidden hunger) among pre-school children.

Notable participants of the roundtable included Dr Daniel McFadden and Dr Bruce N. Ames (from the University of California, Berkeley, USA), Dr Alfred Sommer (from Johns Hopkins University, Baltimore, USA), Dr Ricardo Uauy (from the London School of Hygiene and Topical Medicine, UK), Dr V. Prakash (from the Central Food Technological Research Institute, India), Dr Venkatesh Mannar (from The Micronutrient Initiative, Canada), Dr Rob Russell (from the Tufts University, Boston, USA), and representatives from the Medical Nobel Institute for Biochemistry (Stockholm, Sweden) and the Council for Responsible Nutrition (Washington, DC, USA).

The roundtable was timed to precede the biannual conference of the OCC, held on March 13-15. At the banquet during the OCC conference, SIGHT AND LIFE was honored with the OCC’s Frontiers Science and Humanity Award for its dedication to eradicating nutrient deficiencies and improving child health and development.

To Dr Kraemer, this award, as well as the award from the Micronutrient Forum in 2007, is a great stimulus to the initiative. “SIGHT AND LIFE will do everything in its power to get hidden hunger higher on the global agenda,” he said. “Our resources are limited and we rely to a large extent on our partnerships with stakeholders in academia, non-governmental organizations, UN agencies, and industry but by leveraging these partnerships, we can achieve a great deal.”

Dr Kraemer believes the multi-disciplinary nature of the roundtable makes its messages all the more convincing. He underscores this with a promise: “We aim to publish a scientific paper in a top journal around key messages that are understood not only within our nutrition circles. We’ll use it for advocacy purposes to put nutrition issues higher on the agendas of governments around the world.”

In pace with our own evolution to stay up-to-date and embrace new avenues for knowledge sharing, a podcast series and videocast from the roundtable is available for download from our website, www.sightandlife.org.
Dear Sir,

Earlier in the year, the Centre for Health and Nutrition Promotion (CHANP) applied for and received a consignment of vitamin A capsules from SIGHT AND LIFE. We initially conducted a pilot distribution at some churches in and around Umuahia, the capital city of Abia State. This led to great interest and invitations to distribute the capsules in several communities.

To avoid duplication of efforts, waste of resources and possible over-dosage, we contacted the State Ministry of Health, which is responsible for the state vitamin A distribution program funded by UNICEF. However, we learned that the program has distributed vitamin A capsules in only three of Abia State’s 17 Local Government Areas (LGAs), which leaves many unreached. A similar problem of poor coverage also affected the neighboring Imo State.

To address this problem, CHANP partnered with Skills for Health and Development (SHADE) and St. Francis Hospital, in Obowo LGA in Imo State, to launch a program of vitamin A capsule distribution, free medical services and eye screening. We wrote letters to and visited traditional rulers, opinion and political leaders, and religious leaders for their support in sensitizing and mobilizing people to attend the program flag-off, which took place on August 25, 2007, at the St Francis Medical Centre in Obowo.

On the day of the flag-off, we distributed vitamin A capsules and anthelmintics (albendazole), measured blood pressure, screened eyes and arranged doctor consultations for various complaints. Some cases were immediately treated while others were referred.

We observed two important issues during the flag-off: The first was that over 60% of the people had at least one eye complaint, and the second was that their knowledge of the importance of micronutrients in human health and disease was poor. The program itself proved challenging in terms of our limited manpower to provide prompt attention to everyone during the nine-hour event; limited funds for logistical needs, refreshments and emolument for the volunteers and nurses who worked all day; and lack of IEC materials on nutrition and health. In spite of the challenges, the program was a great success with everyone who attended as well as helped – had there been enough resources, we could have continued until the next day!

We thank SIGHT AND LIFE for the donation of vitamin A capsules because, through the distribution of these capsules, we were able to organize the other services. We also look forward to further assistance in obtaining SIGHT AND LIFE publications – books, newsletters, posters – for our IEC needs as well as SIGHT AND LIFE branded gifts to add color and depth to our program and overall sight-saving and lifesaving efforts in Nigeria.

We would also like to thank Obowo LGA, HRH Eze and Ugoeze Davis Onyeneho, the Olenegalaba 1 of Aganaeke-Avutu Autonomous Community, Obowo LGA, and the director and staff of St. Francis Hospital as well as the people who responded to our call.

Nwuzoma Promise Okorafor
Centre for Health and Nutrition Promotion (CHANP),
World Bank Housing Estate, Umuahia, Abia State, NIGERIA. Email: chanpn2001@yahoo.com

Dr Andy Ukegbu
Skills for Health and Development (SHADE), Umuahia, Abia State, NIGERIA
Dear Sir,

A total of 20,000 vitamin A capsules were received from SIGHT AND LIFE to assist in fighting against vitamin A deficiency, which is prevalent in Mgboko Ofokobe Village in Obingwa, Nigeria. A team from the Semcon Friends Mission Hospital and Motherless Babies Home, which comprised of a doctor, nurses, community health extension workers and student nurses, visited communities in the hospital’s coverage area.

The Semcon Friends Mission Hospital and Motherless Babies Home is located in Ofokobe village, which is in the Obingwa local government area of Abia State in the Eastern part of Nigeria and is home of the Igbo tribe. The state is divided into 17 local government areas, out of which the hospital serves six, including Obingwa, Isiala Ngwa South, Osisioma Ngwa, Aba North, Aba South and Isialangwa North.

The communities are mostly rural and a proportion is illiterate. The health team meets with community members at women’s meetings, village halls, community centers and churches.

During these meetings, the resident doctor, Dr A. Durojaye (a physician trained by UNICEF on Accelerated Child Survival and Development, and Emergency Obstetric Care) usually gives a talk on health alongside the midwives and community health officers. The team then administers the 100,000 IU vitamin A capsules to children aged 6 mo–1 y and the 200,000 IU capsules to older children, and records this. We reached 40 community centers and villages within a period of six months.

On several occasions, while Dr Durojaye saw patients, we found cases that required emergency care, such as blood transfusion for anemia and children with febrile convulsions. Patients with malnutrition were also found and brought to the hospital for counseling of the mother and nutritional support.

We have also distributed vitamin A capsules to other mission hospitals in different locations in the Eastern part of Nigeria to further the fight against vitamin A deficiency. It has been a very successful program and we have begun to include de-worming of children and provision of free medical services to both adults and children in the poverty-stricken villages we have visited.

Our medical mission work has been very rewarding and we request your future support and supplies.

Our aim is to work along in pursuit of the Millennium Development Goals as it affects children and pregnant women.

Rev. Dr Joseph Omelihu, Director of Missions, Semcon Friends Mission Hospital & Motherless Babies Home, Mgboko Ofokobe Village, Box 21 Mgboko Halt PA, Aba, Abia State, NIGERIA
Email: semconfriends@yahoo.com

Dear Sir,

Recently, I had the good fortune to work at the Tamale Eye Clinic (TEC) in Tamale, Ghana, as a volunteer eye surgeon. It was a unique opportunity for me as I not only helped to perform cataract surgeries among the indigenous population, I was also able to transfer skills in Small Incision Cataract Surgery (SICS) to the host ophthalmologist, Dr Seth Wanye, at Tamale. Sponsored by UNITE FOR SIGHT, a US-based eye care NGO, the primary goal of my volunteership was to transfer skills in SICS, and the long-term secondary objectives were to improve the quality of cataract surgery and increase the cataract surgical rate.

I worked closely with Dr Wanye and our daily routine was to examine OPD and post-operation cases from morning to noon. We would then proceed to the Operation Theatre to operate until around six o’clock in the evening or later. After the surgical sessions, we often spent time watching surgical videos and discussing sur-
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Letters to the Editor

Dr Wanye and I performed SICS together on the first day. In SICS, the cataract is removed through a very tiny incision. One of the key steps in this technique is the making of a three-plane self-sealing valvular incision, which facilitates closure of the eye without the application of stitches. On the second day, Dr Wanye performed SICS himself under my supervision, and from the third day onward, he was performing it independently. A month after I left, Dr Wanye wrote to me informing that he had accomplished 45 SICS on his own.

Quackery is rampant in Ghana. We saw two cases of couching at the TEC. I have been informed that the local quack “steals” a substantial number of cataract patients, who should actually be utilizing the services of the eye clinic. The traditional medicine men also advertise on the radio and TV, and claim that their technique is superior to others. It is frightful to know that couching for cataract is still prevalent in 21st-century Ghana. Adequate public education measures are urgently required for better uptake of surgical services at the TEC.

Dear Sir,

We would like to thank SIGHT AND LIFE for your donation of vitamin A capsules to support our efforts to prevent vitamin A deficiency, a common problem among socially and economically disadvantaged people living in Kolkata and rural West Bengal, India. The vitamin A capsules from SIGHT AND LIFE are available at all our clinics, outreach centers and schools. However, the majority of patients receiving vitamin A attend our Tala Park clinic (primarily specializing in Mother and Child Health Care) and at the No.1 School.

As you may know, Calcutta Rescue works to improve the health and quality of life of our beneficiaries. Besides medical care, Calcutta Rescue also puts great emphasis on education, providing free education, food and health screening to nearly 300 slum children. There, the vitamin A capsules are used within the medical program and in accordance with WHO guidelines. In the last year alone, an astonishing 15,000 vitamin A capsules were distributed.

In this way, Calcutta Rescue is glad to be able to contribute, hand-in-hand with SIGHT AND LIFE, to the health and wellbeing of so many children and other disadvantaged people. We hope that SIGHT AND LIFE will continue to support current and new Calcutta Rescue programs.

Ann Bogenschuetz, Calcutta Rescue, PO Box 9253, Middleton Row PO, Calcutta 700 071, INDIA
Email: pharmacist@calcuttarescue.org

Children waiting to receive their vitamin A capsule at Tala Park Clinic.
Dear Sir,

Our service area covers five mandals (Repalle, Bhattiprolu, Nagaram, Nizampatnam, and Cherukupalli), with a population of around 1 million people, who are mostly poor and illiterate. Government health facilities are far from these areas.

Vitamin A deficiency in this area was very high before we commenced our Vitamin A Prophylaxis Program with your kind assistance. The program has been successfully running for the last five years.

We used to see many cases of children with the symptoms of vitamin A deficiency, such as Bitot’s Spots, night blindness, keratomalacia, and phrenoderma, as well as those with hypo-pigmented areas on their skin. These are all completely treatable with your vitamin A capsules. Until now, 150 cases of vitamin A deficiency cases have been recorded and almost all of these cases have been treated with vitamin A capsules.

We are currently conducting nutritional awareness camps in urban slum and rural poor areas, through which we aim to educate and enlist the help of mothers in preventing vitamin A deficiency.

We would like to thank SIGHT AND LIFE again for your donation of vitamin A capsules for children aged 1–6 years in our service areas. Included with this letter are some photos from our program areas, showing children with skin disorders that have been treated with the vitamin A capsules. With this, I request you kindly continue your assistance to our Vitamin A Prophylaxis Program for more years to come.

Yours sincerely

Dr V. Veera Ragha Vaiah, Indian Red Cross Society, Guntur District, AP, INDIA
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Evaluation of TALC’s CD-ROM ‘Community Nutrition’

Teaching-aids At Low Cost (TALC) is conducting a mini-evaluation of their CD-ROM on ‘Community Nutrition’ (which contains documents and other materials relevant to health workers in low-income countries, including several donated by SIGHT AND LIFE – see www.talcuk.org/cd-roms.htm). In order to collect data from intended users, TALC will send a free copy of the CD and a one-page evaluation form to tutors of nutrition courses in low-income countries. Up to 10 free copies of the CD will be sent to all those who fully complete and return the form.

If you are a tutor, or know of any tutors, who can participate in this evaluation, please send names, postal addresses and email addresses to TALC at info@talcuk.org or one of us.

Note: Three free copies of the CD are available to anyone who sends in advance UK£1 or US$2 to cover postage costs – more details from info@talcuk.org
Publications

Editor’s note: SIGHT AND LIFE presents recent publications which may be of particular interest to our readers. However, no publications other than SIGHT AND LIFE publications are available from us, nor do we have any privileged access to them.

Handbook of Nutrition and Food

In a clear and concise format, *Handbook of Nutrition and Food*, edited by Carolyn D. Berdanier, Elaine B. Feldman and Johanna Dwyer, presents quantitative and qualitative information needed by nutritionists, dieticians, and health care professionals.

Significantly revised and updated, the second edition of the book includes contributions from several new authors. This 1500-plus-page volume is part handbook, part textbook, and part encyclopedia, with more than 200 contributors represented in its 72 chapters. Retaining the high level of scientific research, accessible language, and attention to detail of the original, the new edition reflects changes and developments in nutrition research over the past six years in 12 new chapters and three times the number of referential web addresses.

Beginning with an overview of food and food constituents, the book outlines current nutrient analysis systems, techniques for data analysis, and food labeling. The second section reviews nutrition science, including terminology, biochemistry, nutrient-nutrient interactions, and comparative nutrition. There is a detailed assessment in Section Three on nutritional needs throughout the lifecycle. It highlights exercise and the value of vegetarian diets in health promotion and disease prevention.

Section Four considers issues surrounding nutritional assessment, screening, and monitoring tools, including questionnaires, and anthropometric-, psychological-, and energy-assessments.

The book discusses particular challenges relevant to minority populations, school-age-children, and military recruits, and compares dietary guidelines in the USA and around the world. A third of the book relates the latest findings in clinical nutrition, and the prevention and amelioration of a wide range of disease states. In addition to cardiovascular disease, diabetes, and renal diseases, contributions cover cancer treatment, eating disorders, pancreatic health, eye diseases, alcohol metabolism, food allergies, the genetics of human obesity, and herbal supplements.

This large volume touches on almost every pertinent area of nutrition and is a useful addition to nutrition libraries as a general reference. The book is easy to read, the tables and graphs are clear and understandable, and a useful index is provided.

For more information, please visit the website of the publisher, http://www.crcpress.com.

Personalized Nutrition

Personalized nutrition is an emerging but controversial new discipline among nutrition scientists, receiving a lot of attention from the media. It is often misconceived as shopping, guided by a PDA containing individual genetic information. For people in developing countries, personalized nutrition appears unlikely to be available anytime soon. However, the recent issue with iron supplementation in areas with high malaria
endemicity and the consequences of metabolic programming during pregnancy argue for a timely critical evaluation of such a technique even in developing country settings.

When pharmacologists and biomedical scientists develop drug compounds, they take aim at a well-characterized disease. The less well-defined target of optimal health guide nutrition scientists hoping to prevent disease. From one person to the next, optimal health is governed by multiple minor genetic differences, modulated by multiple food bioactivities, resulting in minor changes in gene expression and subsequent phenotypic expression. Identifying and quantifying these subtle differences in health status related to dietary intake requires a complete merging of nutrition science with a number of other disciplines, including molecular biology, biochemistry, bioinformatics, and statistics.

A diet that serves the health of one individual does not necessarily work for all individuals due to differences in genetic predisposition and environmental and lifestyle factors. Hence, diagnostic tools that reflect both the overall health status and genetic predisposition of a particular person at any given time need to be developed. The knowledge obtained would facilitate appropriate nutritional advice to individuals according to their immediate and long-term health needs. Ultimately, we can foresee a time when nutritional products would be tailored for individual consumers.

The success of the introduction of personalized nutrition in society depends on many factors, however. The scientific background for it must be established, the regulatory system must be in place, ethical issues need to be addressed, services and products with clear health benefits must be available, and the accompanying communication must be clear. The editors, Frans J. Kok, Laura Bouwman and Frank Desiere, of Personalized Nutrition aim to define the area of personalized nutrition from both a biomedical and a social science perspective. A group of leading scientists in the field comprehensively address the molecular, physiological, epidemiologic, and public health aspects of personalized nutrition, highlighted by examples from major diseases. Another group of social scientists discuss the behavioral, ethical, and consumer perspectives that will influence the introduction of personalized nutrition.

The book is useful for the education of students in nutrition, behavioral and communication science. Moreover, it provides a reference guide for multidisciplinary scientists, regulators, and the nutrition industry. Personalized Nutrition will likely facilitate the legitimate and successful introduction of personalized nutrition techniques.

For more information, please visit the website of the publisher, http://www.crcpress.com.

The Vitamins – Fundamental Aspects in Nutrition and Health

Author Gerald F. Combs, Jr., writes in the preface to the first edition: “[. . .] one learns best what one has to teach.” Indeed, The Vitamins – Fundamental Aspects in Nutrition and Health is well designed, accurate in every detail, thorough in its coverage, and written in a way that makes reading and studying its material enjoyable.

The updated and expanded third edition of The Vitamins is intended for undergraduates in nutrition, dietetic, biochemistry or physiology studies, and includes many features designed to enhance its usefulness to students and instructors. Each chapter includes study questions, exercises and recommended readings. It easily serves as a desk reference or a workbook for the self-paced study of vitamins.

The book is also intended as a guide for nutritionists, dieticians, food scientists, clinicians, and other professionals in the biomedical and health communities.
depth of coverage in several areas, particularly those related to the health effects associated with vitamin status and/or use, has been expanded in this new edition. It therefore provides a useful reference to the primary literature cited extensively.

The book contains three major sections. The first section characterizes the chemical and physiological properties of the vitamins, with a systematic overview of their general properties, physiological utilization, and metabolism as well as metabolic functions. Vitamin deficiencies are clearly explained in terms of their causes, clinical manifestations and causative biochemical changes.

The second section provides thorough but concise details on each vitamin. A summary identifies their sources and characterizes the absorption and transport mechanisms, cellular metabolism, storage, excretion and metabolic function of each vitamin. Both vitamin deficiency and vitamin toxicity are discussed. The presentation of the vitamin is common but it also includes a list of vitamin-like compounds, including choline, carnitine, myo-inositol, pyroloquinoline quinone, ubiquinones, orotic acid, bioflavonoids, p-aminobenzoic acid, lipoic acid, ineffective factors and unidentified growth factors.

In the third section, food and feed sources of vitamins are identified. Discussions include vitamin content and their bioavailability. The causes of vitamin losses are also provided, which leads to a discussion on vitamin supplementation and fortification. The book expands on the Dietary Reference Intakes (DRIs), also discussing vitamin safety, the hazards of excessive intake and the physiological signs of hypervitaminosis.

Further information on the book, an image collection, links, errata, and author information to complement the text can be found at the book’s companion website, http://www.books.elsevier.com/companions/defaultindividual.asp?

Socio-Economic Differences in Health, Nutrition, and Population within Developing Countries: An Overview

Asset indices are more reliable and much easier to collect than data on income, consumption, or expenditure. Assets are also more constant over time than other similar measures. Their incorporation in nationally representative maternal and child health surveys – e.g. demographic and health surveys (DHS) and multiple indicator cluster surveys – that are carried out in approximately 100 low- and middle-income countries provides an excellent opportunity for equity analyses.

The recent World Bank report, Socio-Economic Differences in Health, Nutrition, and Population within Developing Countries: An Overview re-analyzes 56 recent national DHS data, providing a breakdown of indicators by wealth quintiles. The indicators cover traditional maternal and child health variables, such as child mortality and morbidity, nutritional status of children and women, child immunization, treatment of childhood illnesses, antenatal and delivery care, hygiene practices, use of mosquito nets for malaria prevention, breastfeeding, and micronutrient consumption.

The report provides a snapshot of global inequities in maternal and child health and concludes that:
1. the poor fare worse in terms of health outcomes and are less likely to benefit from effective, lifesaving public health interventions;
2. strategies designed to benefit the poorest, such as primary health care, have proven more likely to reach those who are better off; and
3. the poor will likely be left behind in future improvements because new effective interventions tend to be adopted first by the rich.

To counteract this bleak scenario, the authors propose feasible strategies for monitoring whether country-level programs and interventions are effectively reaching the
poorest individuals. The authors’ main message is that, unless there is a proactive effort to reach the poor through the design and monitoring of maternal and child health interventions, inequities in health will remain unchanged or even worsen as new technologies are introduced.

The report itself and other useful information can be downloaded from the World Bank’s website at the URL, http://go.worldbank.org/3DN4RGGZ70.

Food, Nutrition, Physical Activity, and the Prevention of Cancer: A Global Perspective

Food, Nutrition, Physical Activity, and the Prevention of Cancer: A Global Perspective, the first report published jointly by the World Cancer Research Fund (WCRF) and the American Institute for Cancer Research (AICR) in 1997, has been the most authoritative and influential resource on food, nutrition and cancer prevention over the last decade. It has become the standard text on the subject worldwide and has helped to stimulate research in this crucial area.

Since the mid-1990s, the number of scientific papers in this field has substantially increased. New methods of analyzing and assessing evidence have been developed, largely facilitated by advances in information technology. More evidence has also emerged on the role of specific factors in cancers, particularly overweight, obesity, and physical activity.

In 2001, the WCRF and AICR initiated a global process to develop the second report of this series. The evidence reviewed in the report has led to important recommendations, providing an excellent opportunity to prevent cancer and improve global health. A panel of 21 world-renowned scientists worked on the...
rigorous five-year review process, systematically examining all the relevant evidence using predetermined criteria.

The report reflects a global outlook. Most of the research on diet and cancer comes from high-income countries. However, non-communicable diseases, including cancers, are now major public health burdens in every region of the world, including developing countries.

There is a great deal of concordance between dietary causes of cardiovascular disease and cancer. In general, the recommendations for preventing cancer will also be of great relevance to cardiovascular disease. One of the most pertinent conclusions is that people should aim to be at the lower end of the healthy weight range to ward off cancer and other chronic diseases.

This report is the most comprehensive ever published on the link between cancer and diet, physical activity and weight. The report authors systematically searched for studies published since records began in the 1960s at nine academic institutions around the world. This initially resulted in half a million papers, from which 7,000 were selected on rigorous criteria as the most relevant and robust for inclusion in the report.

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Colophon

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