Micronutrients
and
health

Nutriview 2003/2

Contents in brief:

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Editorial:
A decade of exceptional momentum

Ten years ago, Guatemala's efforts to eliminate micronutrient malnutrition featured prominently in the first issues of Nutriview. We therefore considered it appropriate to ask Noel Solomons, physician, researcher and cofounder of the Center for Studies of Sensory Impairment, Aging and Metabolism (CeSSIAM) in Guatemala City for his views on progress made over the past decade. In 1993 when he received his first issue of Nutriview, his fledgling institution CeSSIAM was 8 years old.

Many of the things about *Nutriview*, which began in 1993 with the publication of two issues, remain the same today, including the editorship of **Anthony Bowley** and advisorship of **Max Blum**. Unfortunately, the other charter advisor, **Laurence Machlin**, has passed away. Many things have also changed, however. With the advent of the informatics revolution, what was once printed exclusively on paper and distributed by the mailman, is now an on-line periodical. The creation of *Nutriview* by F. Hoffmann-La Roche signaled the birth of the private-public partnership attitude by multinational industries; this model of responsible corporate concern has grown and flourished in the area of information, philanthropy and sustained public health intervention.

The inaugural issue of *Nutriview* began with a report on the International Conference on Nutrition, held in Rome in December 1992. It included the following call for government action from the 1992 World Declaration on Nutrition. "*National plans of action should: Aim to eliminate iodine and vitamin A deficiencies and substantially reduce other important micronutrient deficiencies, including iron, folate, vitamin B complex, vitamin C, zinc and calcium, before the end of this decade. Provide legislation for the fortification of foods or water to ensure the supply of necessary micronutrients when existing diets fail to provide adequate levels.*"

The Roman gathering had followed along after the World Summit on Children (1990) and the Meeting on Hidden Hunger (1991). Momentum on micronutrient concerns in public health had built up over the first three years of the 1990s to the point where someone had to launch a newsletter to synthesize and interpret the movement. Fortunately, *Nutriview* jumped into the breach and filled this need.

The year 1993 was also the year that World Bank economist **Alan Berg** gave his Martin Forman Memorial Lecture "*Sliding toward Nutritional Malpractice: A Time to Reconsider and Redeploy*". In this, he proclaimed that there is sufficient knowledge on hand to address all the public health nutrition problems, and called for a virtual moratorium on basic and applied research in developing countries in favour of investment in programs. In the hindsight of a decade, the extraordinary discoveries in heretofore unforetold nutritional situations and in creative social and technological redress of nutritional problems, recounted in *Nutriview*, I rejoice in the fact that Berg's message did not resonate.

For me, 1993 meant travelling to Arusha, Tanzania for the 16th meeting of the International Vitamin A Consultative Group. The fervent of that event was the presentation of the results of the Ghana VAST intervention trial by **David Ross** and the late **Paul Arthur** of the London School of Hygiene and Tropical Medicine. This cemented the conclusion that childhood infectious disease mortality was, indeed, reduced by periodic supplementation of deprived populations with vitamin A.

Each of the 1993 issues of *Nutriview* cites examples from the progress on vitamin A fortification from my adopted home country of Guatemala in Central America. The earlier leadership of Guatemalan biochemist **Guillermo Arroyave** is reflected in the note (in the inaugural issue) on the fortification regulations for salt, sugar and baking flour in the Republic of Guatemala. In the second issue, **Oscar Pineda**, one of the founding coordinators of CeSSIAM, provided a detailed chronological narrative on the evidence for efficacy of sugar fortification as a public health measure to alleviate endemic hypovitaminosis A in Guatemala. As far as I know, however, only two nations—Zambia and Nicaragua—have mandated sugar fortification programs during the last decade. Moreover, the unwritten story in Central America and Zambia has been a lack of firm political will for sustaining enforcement, of encroachment by unfortified sugar sources, and of arguments that fortification regulations represent non-tariff barriers to international food trade. We find ourselves far more advanced in terms of the technology to fortify dietary staples than in the policy-decisiveness and political will to allow fortification to protect the nutritional status of populations.

The dominant topic of 1993, occupying >80% of *Nutriview*'s pages, was vitamin A. Folic acid was treated in a half-page piece in relation to metabolism in pregnancy and prevention of neural tube defects. The word "zinc" only appeared in the context of the Rome Declaration. Other vitamins, iron and iodine were only mentioned peripherally in the context of mobilization against hidden hunger. Increasingly, since its inaugural year, *Nutriview* has found it appropriate to diversify its contents, and diluted initial concentration on vitamin A to address the concerns for other micronutrients such as iron, folic acid, zinc and selenium, as public health campaigns related to these nutrients have emerged.

The early 1990s probably coincides with the time when we really began to speak of "globalization" in the technological and political aspects of our planet. Globalization implies that one exposure affects (or afflicts) all, and motivates the search for efficiency in one-size-fits-all solutions. Micronutrient deficits are part of a larger context of nutritional imbalance and unhealthful dietary patterns in the setting of the deprivation and margination of vast populations and, paradoxically, from the impinging of globalization into their lives. Globalization has crystallized during the past decade, and some of its tenets would act against meting out a differentiated application of appropriate measure tailored to the different deficits and needs of specific populations. To the extent that programmatic solutions and adjustments are actually better accomplished in the context of differing local and community situations, we run against the globalizing currents.

Hence, this paradox represents a niche role and opportunity for *Nutriview*

to focus on science, technology and programmatic concerns as it heads into its second decade. The human right of individuals for food and nutritional security joins the concerns for safety and security in nutrient exposures from our food supply. *Nutriview* can draw in all the new insights and revelations from international research that— despite the protestations of Berg— has continued apace, and provide information on emerging micronutrient deficiencies, nutrient-nutrient interactions and risk-benefit issues. – *Noel W. Solomons, Guatemala City*

Feature:

Gujarat's improved midday meal helps children learn

The Government of India puts primary school education very high on its national agenda. To be successful, however, education not only has to pay attention to infrastructure (buildings and teachers) and curriculum, but, most importantly, to the educability of the children. Efforts cannot succeed unless the children attend school regularly and learn actively [1]. For this, they need to be adequately nourished.

Since 1995, some 40 million primary school children in different parts of India receive a free midday meal (MDM) at an annual cost to the government of about US$20/child. By 2007, the program will be expanded so that all primary school children in the country (about 250 million) have access to it. From 2003, India is also setting up a Nutrition Mission to improve the implementation of its nutrition-related programs. It will be headed by the Prime Minister of India. This is excellent news for the MDM program.

Since the national MDM program began, the State of Gujarat (Western India) has delivered, from its own resources and in addition to the MDM, deworming tablets, iron tablets, vitamin A capsules and iodized salt to its nearly three million primary school children. This 'School Health Inputs' program has produced major improvements in health and nutritional status at an additional annual cost of only US$0.5/child.

A comprehensive evaluation of Gujarat's innovative program by Tara Consultancy Services (TCS, a technical NGO in public nutrition and program-driven research in Bangalore, and India partner of Oxford University's International Partnership for Child Development, PCD) has shown that this cost-effective and sustainable measure has a significant positive impact on growth and hemoglobin levels, intestinal parasite infections and ocular signs of vitamin A deficiency.

The evaluation, commissioned by PCD in 1993, had four parts [2–5]:

1. Focus group interviews with providers and receivers to assess, before the program began, acceptance of deworming, iron and vitamin A.
2. A process evaluation of school health inputs in a representative number of study districts.
3. Study of how the prevalence and severity of intestinal-parasite infestation impacted on the growth and hemoglobin status of the children.
4. Study of how the school health inputs impacted on 3000 representative rural and urban school children in three districts of Gujarat (Baroda, Ahmedabad, Rajkot) before the program began and after one year.

The results of this evaluation are summarized here in the hope that others may be encouraged to adopt such a program either alone or coupled with a school feeding program.

School children are served their midday meal

Program enthusiastically accepted

Guided group discussions were conducted with government officials implementing the program, school principals, teachers, parents and school children before the program started to elicit their opinions on the intended interventions. Program officials said that most of the children suffered from worms and nutritional deficiencies. Many children stated they passed worms, felt tired, and could not see properly in dim light. Parents were generally not aware of such problems in their school-age children.

Both providers and receivers were very positive about the intended program. School principals, teachers and parents said they would help in the dosing rounds and make sure that the children took the 'golees' (tablets). Indeed, when the program got underway, it was enthusiastically accepted by the providers at all levels, as well as the receivers. Community leaders, parents, principals, teachers and children were all for it.

Program well organized

From early 1994, the 'School Health Inputs' program commission worked

very hard to make it a success. It procured albendazole (400 mg), ferrous sulfate (240 mg = 60 mg elemental iron) and vitamin A (200'000 IU) in the amounts needed to dose nearly three million children in the 19 districts of Gujarat. The involved pharmaceutical companies transported the tablets and capsules to the district or 'taluka' (administrative division) where the local health officers were very cooperative in storing them.

Thereafter, local program officers collected their quota and dosed children as prescribed by the program's Expert Technical Committee. Reserve stocks were conveniently stored in the principal's or organizer's lockable office cupboard. As the shelf-life of the tablets and capsules was well beyond two years, provided they were kept in a dark (for vitamin A) and dry place, it was felt they were absolutely safe for further use. Iodized salt was used routinely in the cooked meals.

Training (on dosing, benefits and transient side effects) followed a chain method, in which the Chief District Health Officer trained the deputy collectors (in charge of urban program) and mamlatdars (officers in charge of rural program), who trained the local organizers, who in turn trained the helpers and cooks. This was found to be highly cost effective and efficient. Procurement, logistics, training, distribution and receipt by the school children was highly effective (Table 1).

Deworming is a MUST

Nearly three-quarters of the slum children tested were infested with protozoa (50–55% had E. histolytica) and/or helminths (22–25% had roundworm). Infections were mostly severe to moderate, and affected general health and growth. Infected children were, on average, 2 kg lighter and 3 cm shorter than their noninfected peers. Their average hemoglobin levels were 10.4±0.09 g/dl (noninfected children: 11.6±0.18 g/dl). This negative impact was even worse among older children (11–15 years). The findings clearly indicate that blanket deworming is a must for these underprivileged children before starting a nutritional program.

Impressive health impacts

The representative surveys in nearly 3000 program participants before, and after one year of intervention, showed a remarkably positive impact of the health inputs. Older children benefited more than younger ones. The health inputs produced the following improvements:

- Treated children were, on average, 1.1 kg heavier and 1.1 cm taller than untreated children.
- Hemoglobin values increased, on average, by 1.8 g/dl. The average hemoglobin level after one year of inputs was 12.4 g/dl.
- Intestinal parasite infection rates fell from 71% to 39%. The affected children were greatly relieved to be rid of worms.
- Prevalence of night blindness and eye signs of vitamin A deficiency fell from 67% to 34%. Many treated children said they could see better in dim light.
- Almost three-quarters of the treated children felt that their physical fitness had improved.

Focus group interviews with parents and teachers

Package has clear benefits

Global as well as national studies have shown that low income groups have the most severe dietary deficits of iron and vitamin A (not calories or protein). They are also the most heavily infested with intestinal parasites, which greatly interfere with growth and nutritional status.

It has now been conclusively confirmed that deworming and micronutrient supplementation must be done as a 'package'. Deworming helps to maintain hemoglobin levels for 3–4 months. Adequate dietary iron is most necessary for cognition and the ability to perform hard work [6]. Vitamin A deficiency, not

Table 1: Overview of logistics and impact of health inputs in three study districts

	Urban	Rural
Study district	Baroda, Ahmedabad, Rajkot	
Efficiency of purchase and supply by local pharma company (%)	100	100
Health officer responsible for storage	District Chief	Taluka
Efficiency of logistics to schools (%)	100	100
Coverage by implementer (%)	94–100	42–94
Coverage by school children (%)	71–79	50–67
Impact of health inputs (deworming; iron and vitamin A supplementation)	Hemoglobin ↑ Anemia (Hb<12 g/dl) ↓ Helminth infections ↓ Improved growth and physical fitness	Hemoglobin ↑ Anemia (Hb<12 g/dl) ↓ Ocular signs of VAD ↓ Improved growth and physical fitness

only affects eyesight, it is also associated with common morbidities, especially of the upper respiratory tract, which lead to more school absenteeism. Iodine deficiency, even if mild, affects learning.

This four-in-one-package can have a significant impact on a child's health and education for only US$0.5 a year, while the MDM would cost about US$20. The ideal would be to give both.

Lessons learned

From our experience with the 'School Health Inputs' program conducted by the State of Gujarat, we recommend that the following conditions are met to ensure a cost-effective and sustainable outcome:

- Good school teachers and an adequate curriculum.
- Deworming every six months (together with vitamin A supplementation) as an integral part of efforts to improve nutritional status. Iron tablets can be given at weekly intervals in the classroom.
- Careful forward planning to ensure adequate supplies of deworming tablets/micronutrient supplements.
- Stakeholder collaboration. Support from government, industry, aid agencies, researchers, community leaders, teachers and parents must be ensured at an early stage.
- A simple and practical monitoring system.
- Adequate financing for program evaluation, training and operational research.

Benefits for young adults too

TCS has also shown that the 'deworming + micronutrient package', improves the health, productivity and earnings of women tea pickers [7] and of young women working in the unorganized sector of periurban Bangalore [8]. Men and women in their late adolescence (18 to 25 years) account for most of the unskilled labour force in India.

Global experience endorses our findings in Gujarat as shown in recent reviews [9, 10]. In April 2000, the UN agencies WHO, UNICEF, UNESCO and World Bank launched a joint effort with Education International (a worldwide trade organization of teachers) to "Focus Resources on Effective School Health" (FRESH). This aims to provide services that will improve children's education, nutrition and health through effective partnerships between teachers and health workers, communities and pupils. More than twenty countries are already participating. – *Tara Gopaldas, Director, Tara Consultancy Services, Bangalore, India*

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Feature:

South Africa ready for mandatory cereal fortification

South Africa is in the final stages of introducing legislation for mandatory fortification of maize meal and wheat flour with vitamins A, B-complex, iron and zinc. The final regulations, published in April 2003 following long and careful planning, will become effective before end of this year. The success of this project shows the value of ensuring optimal collaboration between all stakeholders.

National coalition of stakeholders

Current efforts to control micronutrient malnutrition began in 1995—after a nationwide survey discovered a high prevalence of vitamin A deficiency and anemia among the country's children—

with the establishment of an Integrated Nutrition Program within the Department of Health (DOH). Among other strategies, the government chose food fortification as part of an integrated food-based approach together with micronutrient supplementation and dietary diversification. The last of these will be facilitated through a national nutrition education program involving all stakeholders.

A consensus and commitment workshop convened in 1996 allowed stakeholders from government, industry,

consumer organizations, academic bodies and international agencies (UNICEF and the Micronutrient Initiative) to express their concerns and agree on future procedure. This was followed, in 1997 by the creation of a multisectoral task group, the National Food Fortification Program (NFFP), whose task was to set priorities and ensure that key activities were completed accordingly.

In the following years, the NFFP conducted consumer research, assessed the industry situation with regard to fortification technology, evaluated the appropriateness of different iron forms and micronutrient fortification levels, drafted a legislative framework, and devised communication and social marketing plans.

Finding the best alternative

Two basic requirements for a successful food fortification program are to choose an appropriate food vehicle, and to set safe and adequate levels of the micronutrients to be added. A national food consumption survey, conducted in 1999, found that maize and sugar are the foods most frequently consumed (depending on the method used, 75–95% of children regularly consume maize and sugar; up to 65% regularly consume tea, whole milk, brown bread and margarine). The survey also showed that more than half of children aged 1–9 years have inadequate intakes of zinc, vitamin A, iron, vitamin B6, riboflavin and niacin (Figure 1).

The decision to choose cereals as the primary vehicle for fortification was based on their widespread use across all income and age groups, as well as the relative ease of ensuring compliance due to the small number of producers involved. Sugar fortification might be considered later, after trading issues with partner states have been resolved.

This report is based on the recent presentation by Maude de Hoop, Assistant Director, Department of Health, South Africa, at the IVACG meeting in Marrakech, Morocco, with additional input from the South African Nutrition Congress, 2002

Elemental iron, specifically electrolytic iron, was chosen as iron fortificant, after organoleptic evaluations of fortified maize meal and wheat flour showed that ferrous fumarate was unstable on storage, and iron EDTA caused changes in taste. The level of fortificants was also established after extensive stability and organoleptic trials. Some nutrients caused color and flavour changes when added at one-third RDA (for persons aged 10 years and older) per 200g serving of raw maize meal/wheat flour. It was therefore decided to add these at 17–25% RDA (Table 1). At the levels used, consumers were unable to distinguish between fortified and unfortified product.

Millers pledge support

Following publication of the draft regulations in October 2002, stakeholders had three months to submit comments and questions. The regulations cover the manufacture, importation and sale of all maize meal and wheat flour in the country, and set standards for quality control and enforcement, product presentation, labelling, advertising and liability. Millers will be required to use a micronutrient premix obtained from a registered manufacturer, to ensure its correct dosage and storage of stocks, and to maintain appropriate records.

At the annual Nutrition Congress, which was held at the University of Potchefstroom in November 2002, stakeholders had an opportunity to present their views and discuss outstanding issues. Representatives of the milling industry enthusiastically expressed their support for maize meal and wheat flour fortification, in spite of the additional responsibilities and costs involved.

For the largest units (35 millers produce 85% of all maize meal sold in the country; 33 produce 97% of all wheat flour) the initial capital investment may seem considerable. However, when calculated as the additional cost to the consumer, fortification will only result in an annual increase of 2.56 Rand (0.33 US$) per person. Getting the small millers (more than 500 serving rural communities) to comply with the new regulations will be a greater challenge for technical and financial reasons. To help them, a

Fig 1: Percentage of children aged 1–9 years with intakes less than 2/3 RDA daily (South Africa Food Consumption Survey 1999).

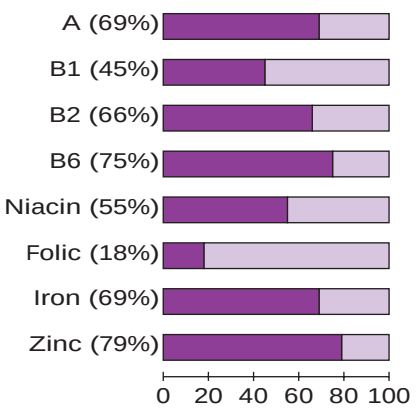

Table 1: Micronutrient requirements for wheat flour and maize meal fortification

Nutrient	Wheat flour		Maize meal	
	RDA goal (%)	Minimum addition required (mg/kg)	RDA goal (%)	Minimum addition required (mg/kg)
Retinol	31	1.786	31	2.085
Thiamin	25	1.944	25	2.187
Riboflavin	20	1.778	17	1.687
Niacin	25	23.684	25	25.00
Pyridoxine	25	2.632	25	3.125
Folic acid	50	1.429	50	2.00
Iron	50	35.00	50	35.00*
Zinc	20	15.00	20	15.00

* 17.5 mg/kg in unsifted maize meal

training and capacity-building program will be implemented.

Developing consumer demand

In recent years, widespread efforts have been undertaken to educate consumers about food fortification. Consumer research, conducted after a broad advocacy campaign, showed that more than 80% of consumers in rural areas, and more than 90% in cities, are in favour of food fortification, and would buy foods with added micronutrients.

Public communication and education will continue through the media, health-care centers, local authorities, teachers, post offices and other organizations. National roadshows will visit areas where malnutrition is particularly severe, and advertising will be conducted at railway, bus and taxi stations. To improve consumer awareness, a special logo created with the help of consumer research (see *page 5*) will be used in all communications. It may also displayed on product labels and in advertising of fortified foods.

Conference report:

Efforts to control micronutrient deficiencies continue

In February 2003, the International Consultative Groups for vitamin A (IVACG), anemia (INACG) and zinc (IZiNCG) held meetings in Marrakech, Morocco, to discuss progress being made in controlling these nutritional deficiencies around the world. Policy makers, program managers, planners and scientists from over 70 countries participated.

IVACG

On February 3rd, Morocco's Minister of Health, Dr Mohamed-Cheikh Biadillah, opened the meeting, acknowledging that the event gave his country an important new impetus to implement programs. Highlights of the IVACG meeting were:

- A clear commitment by policy makers, and widespread consumer demand for supplements are critical for the sustainability of vitamin A programs.
- Alternatives to National Immunization Days must be found for supplement delivery. Several successful national programs (vitamin A days, child health weeks, monthly outreach programs) are already in place.
- Consumption of orange-flesh sweet potatoes is effective in increasing vitamin A intake.
- When implemented on a national scale, staple food fortification improves vitamin A status and reduces need for supplementation.
- Multimicronutrient supplementation, and the impact of infections on nutritional status are emerging as critical areas for scientific study.

INACG

Key messages from the one-day INACG symposium on February 6th are:

- Progress has been made in documenting the causes and extent of anemia, and in the development and evaluation of control programs. To create synergies, control of iron deficiency and anemia must be integrated into health care programs.
- Scientists are developing a vaccine for hookworm, a major cause of anemia in developing countries.
- A recent meta-analysis concluded that iron supplementation has no deleterious effect on infection risk.
- Effective antimalarial strategies are needed to reduce anemia in vulnerable groups. Control of malaria, iron deficiency and anemia should be integrated into routine contacts with health services.
- In the WHO Global Burden of Disease 2000 report, iron deficiency ranked ninth for disability-adjusted life-years (DALYs) lost. This could serve as an effective basis for advocacy measures.
- Communication plays a strategic role in anemia control. Numerous countries, including Morocco, Ghana, Mali and Malawi, have ongoing communication programs.
- In her concluding remarks, Dr Lena Davidsson, Chair of the INACG Steering Committee, stressed the importance of integrated approaches and cross-sectoral collaboration to control iron deficiency and anemia.

IZiNCG

On February 7th, the IZiNCG symposium (the first held together with IVACG and INACG) confirmed the global public health importance of zinc deficiency:

- Zinc plays a prominent role in childhood morbidity (particularly from diarrhea) and a likely role in mortality. Indeed, in the WHO Global Burden of Disease 2000 report, zinc deficiency ranked eleventh for DALYs lost.
- New, internationally appropriate estimates of zinc requirements should facilitate and standardize assessments of adequate intakes in populations. High rates of childhood stunting and inadequate amounts of absorbable zinc in national food supplies indicate that one-third of the world's population may be at high risk of deficiency.
- Advances have been made in Mexico and Pakistan to directly assess population zinc status; an assessment is planned in Thailand. Results showing the effectiveness of zinc programs should emerge from these and other countries.
- Further basic research and efficacy trials are still required to improve recommendations for zinc fortification and supplementation programs.

For more information about the IVACG/INACG meetings, contact the IVACG/INACG Secretariat (Email: hni@ilsi.org). More information on the IZiNCG symposium can be found soon at: www.IZiNCG.ucdavis.edu/

News in brief:

Particle surface area may predict bioavailability of iron fortificants

When seeking a suitable iron form for use as food fortificant, one of the problems that needs to be addressed is bioavailability. This can vary considerably, depending on several factors. It would therefore be useful to have a simple test that could predict bioavailability in advance.

Researchers at the US Department of Agriculture, working in collaboration with SUSTAIN (Sharing U.S. Technology to Aid in the Improvement of Nutrition) and it's partners, think they may have found a solution as far as elemental iron powders are concerned [1]. After feeding rats a diet fortified with one of six commercially available elemental iron powders or iron sulfate, they measured the relative biological value (RBV) of each. The results varied considerably (21–64%; FeSO4: 100%). Examining the powders under a scanning electron microscope, they saw that they differed in physical structure. When they measured the surface area of the different powders with a gas adsorption technique, they found a similarly wide range of values (90–370 m^2/kg). Surface area was inversely related to RBV. Solubility of the powders in dilute acid (pH1.0) at 30 minutes was an equally good predictor of RBV, but solubility at pH1.7 was not.

These data suggest that the bioavailability of elemental iron powders can be predicted by surface area. Solubility in acid at pH1.0 may offer a rapid, low-cost alternative.

1. Swain JH, Hunt JR. Elemental iron powder used for food fortification: does physicochemistry predict bioavailability? Poster. INACG Symposium, 2003, Marrakech, Morocco.

Flour fortification with folate and B12 proposed for Switzerland

In September 2000, the Swiss Federal Office of Public Health established a working group of medical specialists, nutrition scientists and consumer representatives to examine the evidence regarding folate status of the population and to propose measures for reducing the incidence of neural tube defects (NTD). Their report [1] sets out a strong case for mandatory fortification of wheat flour with folic acid (3 mg/kg) and vitamin B12 (10 µg/kg). This would provide an additional daily intake of 275 µg folic acid and 1 µg B12 per person, which should be enough to reduce incidence of NTD and other congenital malformations. By lowering high blood levels of homocysteine, it would offer some protection against atherosclerosis, cancer and dementia as well.

Although no national data on folate status exist, studies in various population groups suggest that suboptimal intakes are common in Switzerland. Evidence shows that an adequate status (>400 µg/l in erythrocytes) can only be achieved with certainty through supplementation or fortified foods. NTD incidence (0.1% of pregnancies) has not changed significantly in spite of efforts to promote periconceptional supplementation. Flour fortification is therefore seen to be more efficient (no extra motivation needed, many pregnancies are not planned) and cheaper (annual cost of fortification <0.02 CHF/person; lower promotion costs). The Swiss health authorities and the public are now called upon to study the evidence presented, and decide on whether the recommendations should be realized.

1. Folsäure: Expertenbericht der Eidgenossischen Ernährungskommission zur Prophylaxe von Neuralrohrdefekten. Bundesamt für Gesundheit. 2002.

Value of single-nutrient supplementation questioned

Most efforts to control micronutrient deficiencies have focussed on single nutrients. However, populations with poor nutrition can be expected to have multiple deficiencies. It would therefore be important to know, how supplementation or food fortification with a single nutrient affects the status of other nutrients, and what interactions can be expected when multiple nutrients are given concurrently.

Wieringa et al [1] have investigated the effects of supplementation for six months with iron, zinc and β-carotene alone, and in combination, on iron, zinc and vitamin A status in Indonesian infants. In those who received placebo, 53% had plasma retinol levels below 0.7 µmol/l, 49% were anemic, 29% had iron deficiency, and 11% had zinc deficiency. In those given iron/iron+zinc, prevalence of plasma retinol levels below 0.7 µmol/l was significantly higher (70/75% respectively). In contrast, only half of them had poor liver stores of vitamin A (placebo group: 81%), suggesting that iron supplementation, by redistributing retinol from the blood to the liver, can induce a state of functional vitamin A deficiency. No significant interactions between zinc and iron, or between zinc and β-carotene were seen. Zinc supplementation (10 mg daily) did not reduce prevalence of zinc deficiency significantly and had no significant effect on iron status.

In another study in Indonesian women supplemented during the second half of pregnancy with iron, folic acid, zinc and β-carotene (submitted for publication) the same group found that β-carotene (4.5 mg daily) was capable of improving vitamin A status only when given together with zinc (30 mg daily). This suggests that zinc plays a role in converting β-carotene to retinol.

From these results, it would appear prudent to treat iron deficiency with an appropriate micronutrient combination, rather than with iron alone.

1. Wieringa FT, Dijkhuizen MA, West CE, et al. Redistribution of vitamin A after iron supplementation in Indonesian infants. Am J Clin Nutr 2003; 77: 651–657.