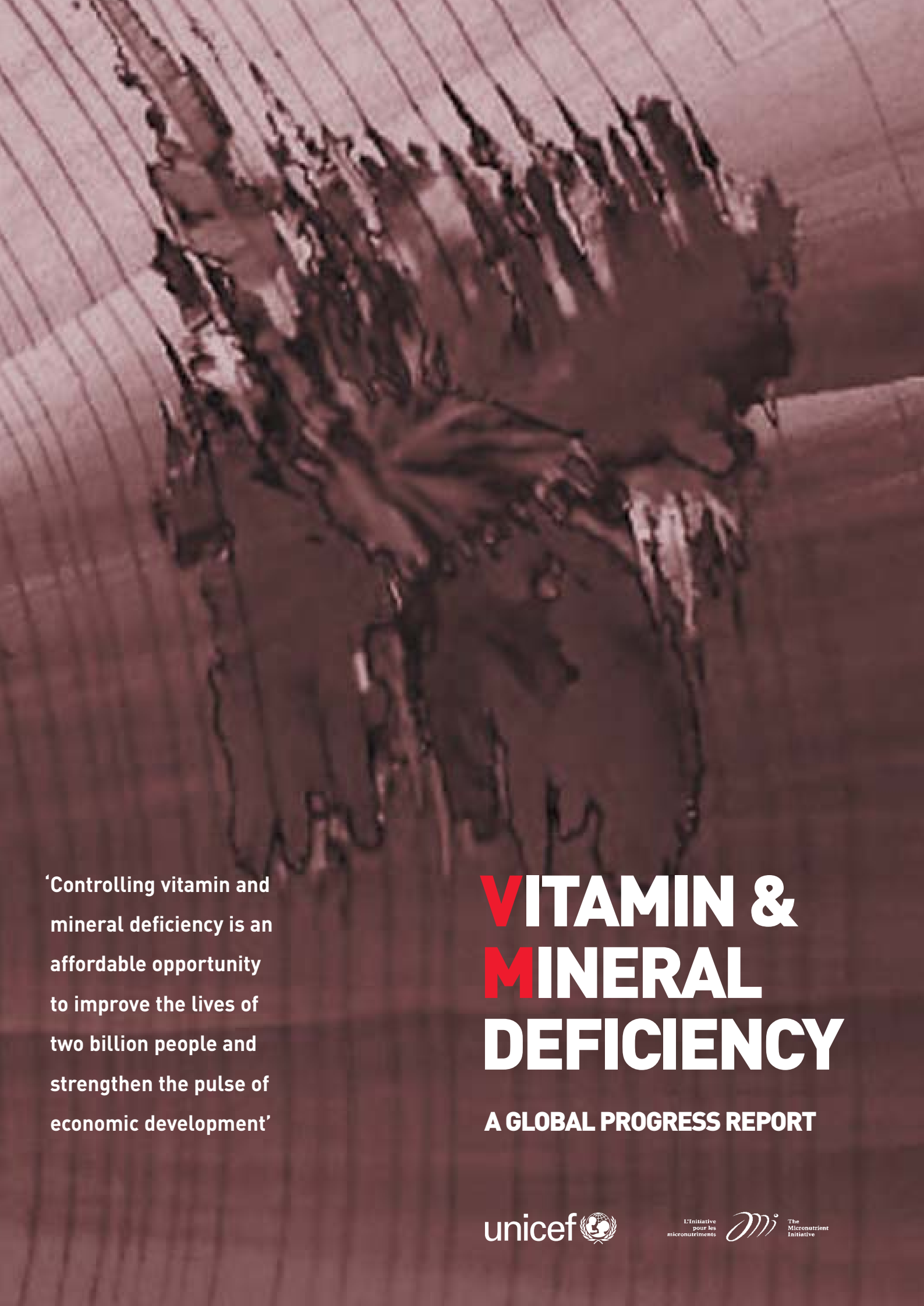


'Controlling vitamin and mineral deficiency is an affordable opportunity to improve the lives of two billion people and strengthen the pulse of economic development'

VITAMIN & MINERAL DEFICIENCY

A GLOBAL PROGRESS REPORT

unicef

L'Initiative pour les micronutriments

The Micronutrient Initiative

"It is no longer a question of treating severe deficiency in individuals. It is a question of reaching out to whole populations to protect them against the devastating consequences of even moderate forms of vitamin and mineral deficiency."

Carol Bellamy, Executive Director, UNICEF

"We now have the knowledge and the solutions that can protect the muscles, brains, and blood of whole populations at an extraordinarily low cost."

Venkatesh Mannar, President, The Micronutrient Initiative

"For nearly 40 years, food fortification has protected the populations of the United States, Canada, and many other countries. It is long past the time when the same protection was available to the peoples of the developing world."

Nevin Scrimshaw, President, International Nutrition Foundation

"Fortifying foods with basic vitamins and minerals is both essential and affordable."

Bill Gates, co-founder, Bill and Melinda Gates Foundation

"The case for the elimination of vitamin and mineral deficiency is compelling beyond description. The return on investment is without equal."

Rolf Carriere, Executive Director, Global Alliance for Improved Nutrition

"Probably no other technology available today offers as large an opportunity to improve lives and accelerate development at such low cost and in such a short time."

The World Bank

"This is a vital economic and humanitarian cause and we in the food industry are uniquely positioned to help progress."

Brendan Stewart, Chairman, Australian Wheat Board

"The cost is minuscule. The benefit enormous. We have acted on this issue both because it is right – and because it presents our business in a positive light."

Philip Punarma, Chief Commercial Officer, Bogosari Flour Mills, Indonesia

"The road to regional health and life-long productivity cannot be passed without removing the obstacle of vitamin and mineral deficiency."

Joseph Hunt, Health and Nutrition Adviser, Asian Development Bank

The front cover graphic is based on an optical microscope photograph of retinol (vitamin A). Courtesy of Michael W. Davidson, Florida State University.

VITAMIN & MINERAL DEFICIENCY

A GLOBAL PROGRESS REPORT

Few outside specialist circles are aware of the scale and severity of vitamin and mineral deficiency, or of what it means for individuals and for nations.

It means the impairment of hundreds of millions of growing minds and the lowering of national IQs.

It means wholesale damage to immune systems, and the deaths of more than a million children a year.

It means 250,000 serious birth defects annually, and the deaths of approximately 50,000 young women a year during pregnancy and childbirth.

And it means the large-scale loss of national energies, intellects, productivity, and growth.

This problem was largely controlled decades ago in the industrialised nations. It could now be controlled world-wide by means that are tried and tested, available and affordable. That is why the World Bank says that *"The control of vitamin and mineral deficiencies is one of the most extraordinary development-related scientific advances of recent years. Probably no other technology available today offers as large an opportunity to improve lives and accelerate development at such low cost and in such a short time"*.

This *Global Progress Report*, issued by the Micronutrient Initiative and UNICEF, offers an overview of the problem, setting out the achievements of the last decade and the challenges for the next. It is issued in the belief that controlling vitamin and mineral deficiency is an affordable opportunity to improve the lives of two billion people and to strengthen the pulse of economic development.

Venkatesh Mannar
President
The Micronutrient Initiative
Ottawa

Carol Bellamy
Executive Director
UNICEF
New York

panels

PART 1
DAMAGE ASSESSED, PROGRESS RECORDED

This report offers a global overview of vitamin and mineral deficiency, of the progress being made against it, and of the challenges that lie ahead if the world is to bring under control a public health problem that prevents as many as a third of the world's people from reaching their physical and mental potential.

To accompany this *Global Progress Report*, individual *Damage Assessment Reports* are also being issued for 80 developing countries. These nation-by-nation audits draw on latest information to present the most comprehensive picture to date of the toll being taken by vitamin and mineral deficiency (VM deficiency). The findings, for countries that are home to approximately 80% of the world's population, are set out in the tables on pages 36 to 39.

A summary makes sombre reading:

- Iodine deficiency is estimated to have lowered the intellectual capacity of almost all of the nations reviewed by as much as 10 to 15 percentage points.
- Iron deficiency in the 6-to-24 month age group is impairing the mental development of approximately 40% to 60% of the developing world's children.
- Vitamin A deficiency is compromising the immune systems of approximately 40% of the developing world's under-fives and leading to the deaths of approximately 1 million young children each year.
- Iodine deficiency in pregnancy is causing almost 18 million babies a year to be born mentally impaired.
- Folate deficiency is responsible for approximately 200,000 severe birth defects every year in the 80 countries for which *Damage Assessment Reports* have been issued (and perhaps as many as 50,000 more in the rest of the world). The deficiency is also associated with approximately 1 in every 10 deaths from heart disease in adults.
- Severe iron deficiency anaemia is also causing the deaths of more than 60,000 young women a year in pregnancy and childbirth.
- Iron deficiency in adults is so widespread as to lower the energies of nations and the productivity of workforces – with estimated losses of up to 2% of GDP in the worst affected countries. *"Vitamin and mineral deficiencies,"* says the World Bank *"impose high economic costs on virtually every developing nation."*
- In practice, vitamin and mineral deficiencies overlap and interact. Half of children with VM deficiency are in fact suffering from multiple deficiencies – adding up an immeasurable burden on individuals, on health services, on education systems, and on families caring for children who are disabled or mentally impaired.

A 'new' problem

This assessment of the world-wide damage being inflicted establishes the starting point of this report – that we are here dealing with a global problem of enormous importance that is as yet little recognised.

In large part this is because VM deficiency is a 'new' problem in as much as its true scale and consequences have only recently been discovered.

For several decades it has been known that micronutrient deficiency – the lack of key vitamins and minerals – brings anaemia, cretinism and blindness to tens of millions of people. But the news of the last decade is that these manifestations are but the tip of a very large iceberg. Levels of mineral and vitamin deficiency that have no clinical symptoms, and that were previously thought to be of relatively little importance, can and do impair intellectual development, cause ill health and early death on an almost unthinkable scale, and condemn perhaps a third of the world to lives lived below their physical and mental potential.

Today it is known that these 'moderate' or 'mild' levels of vitamin and mineral deficiency are extremely common in almost all countries; perhaps 40% of the developing world's people suffer from iron deficiency; probably 15% lack adequate iodine; and as many as 40% of children are growing up with insufficient vitamin A. Indeed so ubiquitous is vitamin and mineral deficiency that it debilitates in some significant degree the energies, intellects, and economic prospects of nations.

The implications of these findings are obviously far-reaching. Most fundamentally, as UNICEF Executive Director Carol Bellamy has said, *"We have to leave behind the old thinking and act in the light of new knowledge: it is no longer a question of seeking out symptoms of severe deficiency in*

01 Improving diets

THE PROBLEM AT THE HEART of this Global Progress Report is a problem of diet. Throughout the developing world, the poor live mostly on a monotonous regime of starchy staples to which small quantities of more nutritious foods are added as money and availability allow. The staple, be it wheat, rice, maize, millet or almost any other grain, does not on its own provide enough vitamins and minerals. To make matters worse, it is likely to contain phytates which inhibit the absorption of iron.

The result is that millions of people are deficient not just in one but in several key vitamins and minerals such as vitamin B12, beta carotene (precursor of vitamin A), iron, iodine, zinc, riboflavin, and folate.

This means that programmes designed to address just one micronutrient deficiency, while they may be a necessary part of an overall strategy, are in themselves an incomplete response (and this is especially true in view of the fact that the lack of one vitamin or mineral can inhibit absorption of another).

Improving and diversifying the food that is eaten by the poor is therefore the most fundamental (though still not comprehensive) approach towards controlling vitamin and mineral deficiency. Unfortunately, it is also the approach that is most dependent on rising incomes.

In practice this has tended to mean that national and international efforts to reduce vitamin and mineral deficiency have concentrated on the more immediately available strategies – supplementation and fortification.

But there is much that government can do to tackle the fundamental dietary problem, even at present levels of economic development. First, education about the particular feeding needs of the very young child is important in all countries (and played a significant part in improving child nutrition in industrialised nations). Panel 4 summarises the essential nutritional knowledge that needs to be put at the disposal of all families. There is much that government can do to promote this. Second, programmes aimed at assisting families and communities to grow and consume a greater variety of foods have shown themselves to be a practical way of reducing vitamin and mineral deficiency – while bringing many other advantages.

An example is the *Bangladesh Homestead Gardening Programme*, a nation-wide initiative now covering more than 180 sub-districts and reaching more than 700,000 households. Launched by Helen Keller International in 1993, the programme works with more than 40 non-governmental organisations in Bangladesh to improve and diversify diets through year-round production of fruit and vegetables. Village level nurseries and homestead gardens serve as the hub of the project – for introducing new agricultural techniques and plant varieties, for supplying high quality seeds, and for technical assistance on such issues as soil fertility, fencing, irrigation, tools, pest control, and access to credit. Through discussion with its overwhelmingly female clientele, the programme also serves as a means of introducing today's nutrition knowledge.

The Bangladesh programme has succeeded in achieving its initial aim of reducing Vitamin A deficiency. It has also increased the quality, variety and reliability of local food supplies; helped to overcome seasonal food shortages by helping families to produce year round crops; helped build community confidence and self-reliance; and increased incomes through the sales of surplus fruit and vegetables. A further advantage of the approach is that it has brought its benefits to everyone in the community as opposed to particular target groups. ■

individuals and treating them. It is a question of reaching out to whole populations to protect them against the devastating consequences of even moderate forms of vitamin and mineral deficiency."

Solutions

But if it is clear that VM deficiency represents a much greater problem than was imagined even a decade ago, it is also clear that for once the world is confronted by a problem for which there are available and affordable solutions.

In summary form those solutions are:

Fortification: Adding vitamins and minerals to foods or condiments that are regularly consumed by a significant proportion of the population – for example flour, sugar, salt, margarine, cooking oil, and sauces. The cost of fortification can be as little as a few cents per person per year.

Supplementation: Reaching out to vulnerable groups (particularly children and women of childbearing age) with vitamin and mineral supplements in the form of low-cost tablets, capsules and syrups. A vitamin A capsule, for example, is effective for up to 6 months and costs as little as 2 cents; a three-month supply of iron tablets costs 20 cents.

Education: Informing the public about the need for supplements or fortified foods, and about the kinds of foods that can increase the intake and absorption of vitamins and minerals. In some cases this might also involve assisting communities to grow and consume a wider variety of foods (Panel 1).

Disease control: Continuing efforts to control diseases like malaria, measles, diarrhoea, and parasitic infections can also help the body to absorb and retain essential vitamins and minerals.

These are the methods that have largely brought the problem under control in the industrialised nations (Panel 9). They are now so inexpensive that they could control VM deficiency world-wide. *"Probably no other technology available today,"* says the World Bank, *"offers as large an opportunity to improve lives and accelerate development at such low cost and in such a short time".*

As this report shows, each of the available solutions involves its own complexities and difficulties; none is a complete solution in itself and all need to be pursued simultaneously and according to the particular contours of need and opportunity in each country. But so serious is the problem, and so affordable the solution, that not to act decisively against it would be to make a mockery of other, more difficult, development targets.

Targets

In May 2002, the General Assembly of the United Nations agreed that control of key vitamin and mineral deficiencies should be one of the global development goals to be achieved in the early years of the new millennium. Specifically, the UN has called for the virtual elimination of iodine deficiency by 2005; the elimination of vitamin A deficiency by 2010; and a reduction of at least 30% in the global prevalence of iron deficiency anaemia by 2010.

The struggle to achieve these goals is already underway. Throughout the 1990s, international agencies have been working with governments, national institutions, and the private sector to fortify foods, improve diets, and extend the outreach of vitamin and mineral supplements. In that time, some remarkable advances have already been made. These achievements, and the main lessons to be taken from them, are also summarised in these pages.

The main burden of this report however, is that the goals will not be achieved, and the impact of vitamin and mineral deficiency will not be substantially reduced, without a more ambitious, visionary, and systematic commitment to putting known solutions into effect on the same scale as the known problems.

In particular, experience to date suggests that dynamic national alliances – involving governments, the private sector, health and nutrition professionals, academics and researchers, civil society and international aid agencies – are the means of unlocking this potential.

In order to galvanise such partnerships, it will first be necessary to create a higher level of awareness of the problem; for one of the main brakes on progress is that VM deficiency remains an issue whose scale and severity is not yet fully appreciated by politicians, press, and public in most nations of the world.

This *Global Progress Report* on vitamin and mineral deficiency, and the accompanying *Damage Assessment Reports* for 80 individual nations, are a contribution towards that end.

Achievements

Alongside the *Damage Assessment Reports* for individual countries, the Micronutrient Initiative and UNICEF have also issued *National Protection Audits* in an attempt to begin tracking, nation-by-nation, the progress made in putting solutions into effect. Where possible, the *National Protection Audits* record the progress made since 1990 and assess the current status of efforts to control VM deficiency.

A summary of what has been achieved over the last decade:

- The global prevalence of iodine deficiency has been halved from 30% to less than 15%. This has been brought about, above all, by a sustained effort to add iodine to two-thirds of the world's household salt. As a result, approximately 70 million new-borns a year have been

02 Vitamin A: 70% not enough

THE CHILDREN LEAST LIKELY to receive vitamin A supplements are those most at risk from vitamin A deficiency. Poverty, poor diets, vitamin and mineral deficiency, and lack of access to goods and services usually march together. And it is this harsh fact that explains why even 70% coverage cannot be counted as a success unless it is used as a base for pushing on towards universal protection.

Reaching the last 30% will in many cases require special measures rather than more of the same. It may involve, for example, mapping geographical areas and communities where coverage remains low, planning special outreach activities, and ensuring that vitamin A supplements are reaching all new mothers within 2 months of giving birth (protecting both mothers and breast-fed infants).

To assist national governments to achieve universal coverage, UNICEF, the Micronutrient Initiative, the Canadian International Development Agency and many other organisations have joined forces to launch new vitamin A initiatives. In 20 countries, assessments will be conducted with national governments to make practical recommendations on how 100% coverage can be achieved. Issues of best practice, bottlenecks, training, investment needs, and the suitability of campaign approaches, will be analysed in each nation's own context.

Two doses needed

To bring about a major reduction in disease and death rates, one dose of vitamin A per year will not be enough. Two doses are needed every year for all children aged 6 months to five years.

Technically, supplementation is necessary three or even four times a year if vitamin A levels are to be maintained; but this is not a practical possibility and would, in any case, raise worries about overdosing in a minority of cases. Fortunately, the relationship between serum retinol (vitamin A) levels and the degree of protection offered is not linear; two doses of supplementary vitamin A given six months apart will offer a significant level of protection even if serum retinol levels fall in the intervening months.

Approximately 40 countries have achieved the intermediate target of 70% coverage of children under five with one supplement a year. The table below lists the 14 countries that have achieved this same intermediate target with two-doses of vitamin A. ■

In extreme cases, vitamin A deficiency attacks the eye, leading to permanent blindness. Much more widespread is the kind of vitamin A deficiency which has no outward sign but which opens the doors to disease and leads over a million children a year to their deaths.
Photograph: Jørgen Schytte

COUNTRIES REACHING 70% OR MORE OF CHILDREN UNDER 5 WITH TWO VITAMIN A SUPPLEMENTS PER YEAR

	% covered 1st dose	% covered 2nd dose
Afghanistan	84	76
Bangladesh	90	90
Chad	91	88
Ghana	100	100
Lao PDR	70	70
Myanmar	97	96
Nepal	98	96
Niger	89	88
Pakistan	100	100
Philippines	84	76
Senegal	85	83
Sierra Leone	91	73
Tanzania	93	81
Zambia	83	75

Source: UNICEF, 2003

protected, in some degree, against mental impairment.

- More than 40 developing countries are now reaching two-thirds or more of their young children with at least one high-dose vitamin A capsule every year. Coverage with the necessary two-doses is much lower (Panel 2), but the effort to date is estimated to be saving the lives of more than 300,000 young children a year and, over time, preventing the irreversible blindness of hundreds of thousands more.

- An international movement to fortify all wheat flour with iron and folic acid (as in the United States and Canada) is beginning to gather momentum. Indonesia, Jordan, Nigeria and South Africa have recently acted, bringing to 49 the total number of countries with flour fortification laws.

- Many more developing countries have begun the process of fortifying other staple foods and condiments with essential vitamin and minerals – from salt, sugar and margarine to cooking oil and soy sauce.

- In addition to these advances, there are signs that the seriousness and urgency of the VM deficiency issue is beginning to be more widely realised. In 2002, for example, a new $70 million *Global Alliance for Improved Nutrition* (GAIN) was launched – with the support of the Bill and Melinda Gates Foundation, the Micronutrient Initiative, and the aid programmes of Canada, Germany, the Netherlands and the United States (Panel 12).

Many of these achievements stem from the resolutions made at the *World Summit for Children* held by the United Nations in 1990, and are a tribute to the power of international goals and commitments and to the subsequent efforts made by a great many individuals and organisations. Nonetheless, with almost a third of the planet affected in some degree by a problem for which a clear solution beckons, anything less than rapid progress would be unconscionable. This report therefore turns next to the distance that still has to be travelled, and to the lessons from the last decade that must guide the efforts of the next.

PART 2
A JOB LESS THAN HALF DONE

Despite the achievements of recent years the fact remains that few nations have moved decisively against VM deficiency by deploying the full range of known solutions on a nation-wide scale. Often the action taken has been focused only on one particular deficiency, or has lacked the ambition and vision necessary to reduce multiple deficiencies across entire populations. If the goals accepted by the international community are to be achieved, then the years immediately ahead will need to see action against vitamin and mineral deficiency move onto a new level.

The following pages overview the challenges deficiency by deficiency; but in practice multiple deficiency is the norm. Analytically and historically, it has been usual to disaggregate the problem; biologically and operationally it makes more sense to take an integrated view. It is for this reason that this report uses the integrated term 'vitamin and mineral deficiency' or VM deficiency.

Iodine

A solution to the problem of iodine deficiency has been available for more than 80 years. Beginning in Switzerland in 1921 and in the United States in 1924, most industrialised nations have mandated or permitted the iodisation of salt (Panel 9). In India, the effectiveness of iodised salt was demonstrated in the 1950s in a landmark study by the late Vulimiri Ramalingaswami. But for most of the 20th century other priorities prevented the developing world from addressing the problem. When the consequences of even moderate iodine deficiency began to be appreciated in the 1980s, international agencies like UNICEF began to press the case for the iodisation of household salt world-wide.

There followed a decade of remarkable efforts by scientists and researchers, regulators and inspectors, governments and non-governmental organisations, and by thousands of individual salt producing companies all over the developing world. UNICEF led the global effort. Aid donors like the Canadian International Development Agency (CIDA) provided much of the initial funding. Non-governmental

03 'Super Salt' breakthrough

A BREAKTHROUGH in 'double-fortifying' salt with both iron and iodine has been made by researchers at Toronto University, opening the way for a daily dose of iron to be added to the diets of billions of people. At present, iron deficiency lowers the health and productivity of 40% of the developing world's population and impairs the mental development of 40% to 60% of its children (Panel 5).

Salt is consumed in small, fairly constant daily amounts by almost everybody and is almost always 'bought-in', often from only a small number of suppliers. This makes it the ideal vehicle for carrying extra vitamins and minerals. Until now the problem has been that iron and iodine interact with each other and with impurities and moisture in salt. The breakthrough, by researchers at Toronto University, overcomes these problems by encapsulating both the iron (ferrous fumarate) and the iodine (potassium iodide) in a coating of dextrin that seals off the micronutrients from each other and, to some extent, from moisture. The 'micro-encapsulated' iron and iodine is then mixed in with regular salt crystals.

Field trials in three continents have shown that double-fortified salt is as effective as a weekly iron supplement, while still delivering all the benefits of iodised salt. Acceptability, colour, taste, stability, have all been successfully tested.

Some problems remain. The salt used for double-fortifying has to be of a higher grade, and needs more water-resistant packaging. For salt normally costing 20 to 50 cents a kilo, the additional cost might be only 5% to 10%. But the cheaper grades bought by the poor at 5 to 7 cents a kilo would also need better packaging, which might double the commercial price.

Nonetheless the absolute increase in cost is small for what may be one of the most cost-effective interventions in public health history. 'Super Salt' offers self-sustaining progress against two of the developing world's biggest nutritional problems at a cost of approximately 20 cents per person per year. Even if none of the bill were picked up by consumers, the total annual cost for the poorest third of the world's population would amount to about $400 million – about as much as the population of the United States spends on running shoes every two weeks.

Following the technical breakthrough, the need now is for governments, salt producers, and food companies to make an equivalent 'marketing breakthrough'. This might involve public-private partnership agreements to help put double-fortified salt at the disposal of entire populations.

Work is continuing at Toronto University to make the technology cheaper and more robust so that developing countries can begin low-cost production of the iron-and-iodine pre-mix for distribution to salt producers.

The Micronutrient Initiative, which has devoted approximately $3 million on research into double-fortified salt spanning more than a decade, is now preparing to offer assessments and guidelines to governments and salt companies around the world. India, Kenya and Nigeria are already moving into commercial production and several major salt companies are showing interest in the new product.

Over the next five years, the Micronutrient Initiative plans to take double-fortified salt to scale in 15 to 20 counties. The hope is that by providing about a third of daily iron requirements, 'Super Salt' can improve the overall iron status of populations. This would reduce the scale of the problem and allow other interventions to be focused on those most at risk. *"The goal of reducing all forms of iron deficiency by one third by 2010,"* says Venkatesh Mannar, President of the Micronutrient Initiative, *"is now a distinct possibility."* ■

organisations made major contributions (most notably the Kiwanis whose 600,000 members in 83 countries have raised more than $70 million for salt iodisation programmes). Not least, thousands of the world's salt producers, most of them private and many of them small, responded to the call.

By the year 2000, iodine was being added to approximately two-thirds of the developing world's salt and approximately 70 million new-borns each year were being protected against the threat of mental impairment. Today, over 100 nations have salt iodisation programmes. Some of the world's poorest countries – including Bangladesh, Cameroon, Eritrea, and Nigeria – have all passed the 70% mark for salt iodisation. The People's Republic of China, which made a commitment to universal salt iodisation following the World Summit for Children in 1990, iodised 90% of its salt in under 10 years.

Summing up this achievement, the President of the Micronutrient Initiative, Venkatesh Mannar, has said that *"the effort to date shows it can be done. With a sustained effort and innovation to reach those who have not yet been reached, salt iodisation can become a universal and permanent solution to a problem that has limited the progress and potential of a significant proportion of humanity."*

Fig. 1 presents this story in the form of a world-wide 'Iodine Protection League', ranking nations according to the percentage of household salt that has been iodised.

The statistical tables on pages 36 to 39 show for each of 80 countries the current best-estimate of the prevalence of iodine deficiency as measured by the total goitre rate or TGR. This is a measure that must be treated with caution. On the one hand, goitre (the swelling of the thyroid gland) is a clinical symptom and is therefore likely to underestimate the extent of the

FIGURE 1
COUNTRIES RANKED BY PERCENTAGE OF HOUSEHOLDS CONSUMING IODISED SALT, BY REGION, 2000-2003

	Estimated % of household salt iodised
South Asia	
Bhutan	95
Bangladesh	70
Nepal	63
India	50
Pakistan	17
Afghanistan	15
East Asia and Pacific	
China	93
Viet Nam	77
Lao PDR	75
Thailand	74
Indonesia	65
Myanmar	48
Mongolia	45
Philippines	24
Cambodia	14
Latin America and Caribbean	
Nicaragua	96
Peru	93
El Salvador	91
Venezuela	90
Brazil	87
Bolivia	85
Paraguay	83
Honduras	80
Guatemala	49
Dominican Rep.	18
Haiti	12
Eastern and Southern Africa	
Eritrea	97
Burundi	96
Uganda	95
Zimbabwe	93
Kenya	91
Rwanda	90
Lesotho	69
Zambia	68
Botswana	67
Tanzania	67
Namibia	64
South Africa	62
Mozambique	62
Swaziland	59
Madagascar	52
Malawi	36
Angola	35
Ethiopia	28
Western and Central Africa	
Nigeria	98
Congo, Dem. Rep.	93
Central African Rep.	86
Cameroon	84
Mali	74
Benin	72
Togo	67
Chad	58
Sierra Leone	23
Burkina Faso	22
Senegal	16
Niger	15
Gabon	15
Gambia	8
Mauritania	2
Guinea-Bissau	1
Middle East and North Africa	
Iran	94
Lebanon	87
Egypt	80
Syria	80
Morocco	41
Yemen	39
Central and Eastern Europe and Newly Independent States	
Armenia	83
Kazakhstan	76
Turkmenistan	75
Turkey	64
Kyrgyzstan	27
Azerbaijan	26
Tajikistan	20
Uzbekistan	19
Georgia	8

Source: UNICEF

04 What families need to know

EIGHT UNITED NATIONS AGENCIES, co-ordinated by UNICEF, have drawn on world-wide experience and scientific knowledge to list the essential nutritional information that every family needs to now when it comes to protecting the normal growth of young children.

Those essentials are:

- A young child should gain weight rapidly. From birth to age two, children should be weighed every month. If a child has not gained weight for about two months, something is wrong.
- Breast milk alone is the only food and drink an infant needs until the age of six months. After six months, the child needs a variety of other foods in addition to breast milk.
- From the age of six months to two years, children need to be fed five times a day, in addition to sustained breastfeeding.
- Children need vitamin A to resists illness and prevent visual impairments. Vitamin A can be found in many fruits and vegetables, oils, eggs, dairy products, fortified foods, breast milk or vitamin A supplements.
- Children need iron rich foods to protect their physical and mental abilities. The best sources of iron are liver, lean meats, fish, eggs, and fortified foods or iron supplements.
- Iodised salt is essential to prevent learning disabilities and delayed development in children.
- During an illness, children need to continue to eat regularly. After an illness, children need at least one extra meal every day for at least a week.

This information is extracted from *Facts for Life*, a guide to 'what every family needs to know' about safe motherhood, breastfeeding, child development, nutrition and growth, immunisation, diarrhoea, malaria, and HIV/AIDS.

Facts for Life is published jointly by UNICEF, UNESCO, UNFPA, UNDP, UNAIDS, the World Food Programme, and the World Bank. Since its first publication in 1988, *Facts for Life* has been regularly updated. More than 15 million copies in 200 languages are now in use throughout the world.

Facts for Life is available on-line in PDF file format. The printed version can also be ordered on-line from UN Sales ($7.50 plus shipping). www.unicef.org

underlying problem. On the other hand, the TGR is a population-wide figure that does not yet reflect recent advances in salt iodisation. Nonetheless it is an indicator to which all nations should attend. It is now accepted that any country with a TGR of 10% or more is likely to suffer a population-wide lowering of intellectual capacity by between 10% and 15% (with all that this implies for families and communities, for educational investments and school performance, for individual productivity and for national development efforts).

Of the 80 countries reviewed, all but 14 have a TGR in excess of 10% and 24 of those nations, including some of the most populous like India and Pakistan, have rates of 20% or more.

These rates are now in decline in almost all nations as salt iodisation begins to deliver its benefits. But 60% or 70% salt iodisation is not enough. Every year 50 million children are still being born without the protection that iodine offers to the growing brain and body. Approximately 18 million of those children will suffer some significant degree of mental impairment.

Iodine deficiency therefore remains the single greatest cause of preventable mental retardation in the world today.

FIGURE 2
DISPARITIES IN THE CONSUMPTION OF IODISED SALT, SELECTED COUNTRIES, BY WEALTH QUINTILES, 2000

	poorest 20%	richest 20%	ratio of poorest to richest
Philippines	12	53	4.6
Cote d'Ivoire	15	56	3.8
Senegal	9	30	3.4
Dominican republic	10	33	3.4
Mongolia	22	69	3.2
Tajikistan	11	31	2.9
Lesotho	36	94	2.6
Sierra Leone	17	32	1.9
Madagascar	43	80	1.9
Vietnam	31	56	1.8
Myanmar	38	64	1.7
Azerbaijan	20	33	1.7
Niger	11	17	1.6
Chad	52	70	1.3
Bolivia	52	68	1.3
Congo Dem. Rep.	68	81	1.2
Cameroon	78	91	1.2
Comoros	78	85	1.1
Swaziland	57	60	1.1
Central African Rep.	84	88	1.0
Rwanda	91	94	1.0
Burundi	96	95	1.0
Lao PDR	76	73	1.0
Togo	29	28	1.0
Angola	34	33	1.0
Zambia	77	65	0.8
Sao Tome & Principe	49	40	0.8
Population weighted average	37	60	1.6

Source: Multiple Indicator Cluster Surveys with further analysis by UNICEF

Salt pyramid

The road to universal salt iodisation is now likely to become steeper. The one third of the developing world's people who are not yet protected by iodised salt are, by and large, the more marginalised populations – economically, culturally, or geographically – and are likely to be more difficult to reach.

In India, for example, a fifteen-year effort had brought iodised salt to almost two-thirds of the population by the year 2000; but by and large it is the more expensive grades of salt that have been iodised. Protection is therefore still not reaching, in any reliable way, the 300 million people at the bottom of the economic pyramid who tend to use poorer grades of salt. If iodised and non-iodised salt are both available in the market place, and if the iodised product is even slightly more expensive, the poor will be effectively excluded.

Recent data from UNICEF confirms that this concern is not limited to India. Across 28 countries studied, the richest fifth of the population were found to be 50% more likely to be consuming iodised salt than the poorest 20% (Fig. 2). In some, the inequality is extreme; among the poorest fifth of the population in the Philippines only just over 10% are estimated to be consuming iodised salt as opposed to more than 50% among the richest fifth.

A realistic overview must also acknowledge that achieving salt iodisation is only half the battle. Sustainability is all. And in 2004 there are worries that salt iodisation levels are slipping back in countries such as India, Indonesia, Bolivia, Russia, and Vietnam.

India, with the largest number of iodine deficient people, appears to

05 The iron gap

WHY ARE MORE THAN HALF the developing world's children deficient in iron in the critical stages of brain development between the ages of 6 months and 2 years? And what can be done about it?

In the best of circumstances, a breastfed child of normal birth weight, with a mother who is not iron deficient, will have adequate iron for the first six months of life – about half from breast milk and half from the iron stores inherited from the mother at birth.

But it is when breast milk is complemented with other foods (at about the age of six months) that the problem becomes critical. The stores inherited at birth are now gone. Continued breastfeeding can still supply about 50% of the iron needed. But the other 50% cannot be provided by the low-density porridges, gruels and mashes that are the usual 'complementary foods' for children across the developing world. Indeed it would take 75 to 125 grams of meat each day to provide the necessary iron – an impossible amount for a majority of the world's families. As a result, hundreds of millions of children aged 6-to-24 months fall into iron deficiency, their diets simply failing to meet the complex and unforgiving demands of the growing mind and body at this vital, vulnerable period.

Bridging the 6-to-24 month 'iron gap' is therefore one of the most crucial issues in world nutrition.

The problem can be solved – if national governments make the commitment to put the full range of solutions into practice on the necessary scale.

First, nation-wide efforts can be made to inform families about the very particular feeding needs of young children (Panel 4). Second, iron intake will need to be supplemented – just as it is for children in the industrialised nations. Clinics and health centres can deliver iron in syrup form; or it can be supplied by special spreads or by small sachets of vitamins and minerals added to the gruels and mashes given to small children (in addition to breastfeeding).

It can also be supplied by commercial infant foods and cereals that have been fortified with iron.

Food companies have already played a significant role in reducing vitamin and mineral deficiency among children in the industrialised nations; and they must now be called upon again if millions of children in the developing world are to enjoy the same protection. The market for fortified cereals is growing in many parts of the developing world. But if the poorest are to benefit from fortified cereals government may have to introduce incentives and public-private partnership arrangements.

Nonetheless, it is likely that in the initial stages the main beneficiaries of commercial fortified infant foods will be the not-so-poor. But as the market grows in response to education and consumer demand, companies are likely to develop new products and marketing strategies that will eventually lead to increases in volume and reductions in cost, making it more feasible to market products to poorer and more rural populations.

Government can accelerate this process by many means, not least of which is government-led public education – a point stressed during the 2002 Manila Forum on Food Fortification Policy which concluded: *"If consumers today were aware of how much they need micronutrients and understood the difference between fortified and non-fortified products, private food companies would already be working hard to satisfy their demands."* ■

have allowed salt iodisation to slip back towards 50%. Iodine deficiency is reported to be re-surfacing in the Balkans, and in some Central Asian Republics the level of salt iodisation has fallen towards the 25% mark – lower than in many parts of Africa. In Bangladesh, after remarkable early successes, the momentum of the iodisation effort seems to have stalled at a point well short of the goal of universal salt iodisation.

Globally the proportion of people consuming iodised salt is thought to have fallen from 70% to about 65% since the year 2000. If true, this means that 5 million fewer children are being protected from mental impairment every year. With few exceptions, it is not the capacity of countries to iodise salt that has decreased; it is the commitment that is showing signs of faltering.

Significantly, the People's Republic of China is pressing on past the already achieved 90% target and towards 100% salt iodisation. A key to this sustained effort has been China's formal five-yearly review process designed not only to monitor progress, budgets, training, and best-practice but to renew high-level political commitment to universal salt iodisation.

There is much that can be learnt from such experiences as countries struggle to sustain political will and to find practical solutions to particular logistical problems at national level. To facilitate this mutual learning, an International Network for the Sustained Elimination of Iodine Deficiency has been created with the aim of drawing on world-wide expertise to solve particular problems and fill in the major gaps in salt iodisation's progress.

In overview, the initial push towards salt iodisation in the 1990s has brought remarkable progress; but there are signs that momentum may be being lost in the early years of the 21st century. This is therefore a critical time. Eliminating iodine deficiency demands a renewed drive to iodise the salt consumed by the poorest third of the population in each nation. The fact that two-thirds of the developing world's salt has been iodised should not be taken to mean that the world is two-thirds of the way towards the goal; indeed to say that the half-way point had been reached would be to overstate the case.

Vitamin A

Efforts to control vitamin A deficiency over the last decade have broadly paralleled the progress of salt iodisation.

It had long been known that lack of vitamin A was a cause of impaired vision and blindness. But in the late '70s and early '80s, research in Indonesia revealed the real depths of the vitamin A problem: children with even mild vitamin A deficiency – and no clinical symptoms – were found to have 25% to 30% higher death rates (even when overall nutritional status was controlled for).

Initially greeted with scepticism, these extraordinary findings were subsequently confirmed by studies in a number of countries. Today it is accepted that immune systems are compromised by vitamin A deficiency and that hundreds of millions of children are thereby at increased risk of disease and early death. In its World Health Report for 2003 the World Health Organisation (WHO) estimates that vitamin A deficiency is responsible for 16% of the global burden of disease caused by malaria, 18% of the global burden of diarrhoeal disease, and a significant proportion of all cases of acute respiratory infections and measles.

In short, lack of vitamin A opens the door to disease and leads the way to approximately 1 million child deaths every year.

Less easy to measure is the impact on child malnutrition and on normal growth. Almost all illnesses in early childhood are a set-back to growth. And if such illnesses occur too frequently, leaving too little opportunity for growth to regain its normal trajectory, or if catch-up growth is inhibited by vitamin A deficiency or by families not knowing that extra feeding is required after an illness, then poor growth will be the result. The fact that three or four out of every 10 children in the developing world are growing up without the protection of vitamin A is therefore critical to the normal physical and mental growth of children in every developing country.

The response to these findings has been a renewed effort to make vitamin A supplements available to hundreds of millions of children.

UNICEF, WHO, the Micronutrient Initiative, CIDA, USAID, and many other organisations are today working with national governments to distribute more than 400 million vitamin A capsules a year and to support supplementation programmes with education and training. As a result, approximately half the children of the developing world are protected to some degree and an estimated 300,000 young lives are being saved each year (Fig. 3).

One shot not enough

Such progress in extending the protection of vitamin A supplements to so many tens of millions of women and children in villages, towns and cities throughout Africa and Asia deserves to be recognised as one of the most significant public health achievements of recent years. But as with iodine, it must again be said that the road ahead is both longer and steeper than the road already travelled – and for similar reasons.

First of all, one vitamin A capsule a year is not enough – as is clearly shown by the fact that many of the nations with high vitamin A coverage rates continue to have high deficiency rates. In the 80 developing countries for which individual *Damage Assessment Reports* have been

06 'A women's problem'

IN THE SEVERAL DECADES since measurement of iron deficiency began, very little headway has been made against the problem. Goals have been set but not met, and resignation seems to have replaced determination.

In part this is because there is no easy solution and the approaches that are effective have considerable drawbacks. But lack of priority may also be an underlying reason for the lack of progress. For many decades, iron deficiency has been seen as a 'women's problem'. Moreover it is so common, affecting up to three-quarters of pregnant women in some parts of Asia for example, that it has come to be regarded as normal. Among policy-makers, the unspoken view has seemed to be that women somehow cope, and that iron deficiency is not a high enough priority to justify a major national effort to reduce it.

This view, never justifiable, must surely now give way under the weight of evidence linking iron deficiency in early childhood to substantial effects on physical and intellectual development. In most developing countries today, iron deficiency is now estimated to be preventing 40% to 60% of children from growing to their mental potential.

But crucial as the new findings are, they should not be allowed to eclipse the 'old' problem of iron deficiency among the world's women.

For almost 500 million women of childbearing age – approximately 40% of all 15 to 49 year-old females in the developing world – anaemia remains a fact of life. Yet these are the women who fetch the developing world's water and fuel, light its fires, cook its meals, tend its animals, clean its compounds, wash its clothes, and shop for its needs. Most demanding of all, they look after its old and its sick and bear and care for its children.

Iron deficiency affects approximately 40% of women in the developing world, undermining health and energy. In childbirth, lack of iron can be tipped into severe anaemia – which kills more than 60,000 young women a year. A three month supply of iron supplements costs about 20 cents. Photograph: Claude Sauvageot

For many, a life lived on the edge of severe iron deficiency is tipped into the abyss by pregnancy and childbirth. More than 1,000 severely anaemic young women die every single week in the developing world because their bodies lack sufficient iron to cope with the stresses of childbirth.

Even this sad statistic does not take the full measure and meaning of the problem for those many hundreds of millions of women who do not die of iron deficiency but who must live with it. Iron supplements cost less than 20 cents for three months supply. But they could liberate a significant proportion of the world's women from the kind of nagging tiredness and general ill-health that makes each task an unwelcome effort, each day a day of drudgery, and leaves too little vitality and energy for the common enjoyments of life. ■

FIGURE 3
COUNTRIES RANKED BY PERCENTAGE OF CHILDREN RECEIVING VITAMIN A SUPPLEMENTS, BY REGION, 2000-2003

	% of children receiving at least one high-dose vitamin A supplement per year		% of children receiving at least one high-dose vitamin A supplement per year
South Asia		Namibia	84
Pakistan	100	Madagascar	83
Nepal	98	Zambia	83
Bangladesh	90	Angola	75
Afghanistan	84	Malawi	75
India	24	Mozambique	71
		Eritrea	67
East Asia and Pacific		Uganda	37
Myanmar	97	Ethiopia	16
Mongolia	93		
Philippines	84	**Western and Central Africa**	
Lao PDR	70	Congo	100
Indonesia	61	Ghana	100
Viet Nam	59	Guinea-Bissau	100
Cambodia	57	Liberia	100
		Cameroon	99
Latin America and Caribbean		Mauritania	98
Honduras	62	Burkina Faso	97
Guatemala	60	Benin	95
Bolivia	44	Chad	91
Dominican Rep.	35	Gambia	91
Haiti	30	Sierra Leone	91
Peru	6	Central African Rep.	90
		Gabon	89
Eastern and Southern Africa		Niger	89
Burundi	95	Senegal	85
Rwanda	94	Congo, Dem. Rep.	80
Tanzania	93	Mali	80
Kenya	90	Nigeria	77
Botswana	85	Togo	77

(countries not listed = no data available) Source: UNICEF

prepared, the average prevalence of sub-clinical vitamin A deficiency in young children remains at approximately 30%, with several countries recording levels of 50% or more. Moreover, the *Damage Assessment Reports* strongly suggest that it is the countries achieving high levels of coverage with two rounds of vitamin A supplementation that are achieving a large and measurable impact. It would therefore seem sensible to make 'two-dose' coverage into the new standard by which this form of protection is measured and monitored over time.

Secondly, progress may already be slowing down as the supplementation effort runs up against the kind of economic, social, and geographical barriers which make it more difficult to reach those children who are not in regular and reliable contact with health services (Panel 2).

Global statistics (Fig. 4) tell the overall story up to the year 2000, but have little to say about more recent supplementation trends. Nonetheless, they indicate how sharp an inflection point is needed to meet the UN goal of eliminating vitamin A deficiency by the year 2010.

As Fig. 4 illustrates, India has by far the largest percentage as well as the largest absolute number of vitamin A deficient children. So far, the country has struggled to reach even a third of its under-fives with supplementary vitamin A (in syrup form). There are now signs of a new effort beginning that could see a substantial rise in protection for India's children.

In Latin America and the Caribbean there has been a sustained effort to defeat vitamin A deficiency by fortifying sugar and, in some cases, cereals. Beginning in the 1970s, this has involved a major commitment by sugar producers, legislation by governments, and many years of advocacy and assistance from international agencies such as UNICEF and the Pan-American Health Organisation. The results have been impressive, with some countries recording a drop of 50% or more in the prevalence of vitamin A deficiency.

Zambia, with only one sugar producer, has been adding vitamin A to sugar since 1998. Cooking oil has been fortified with vitamin A in Morocco, Pakistan, Oman and Yemen. In the rest of the developing world, the potential for adding vitamin A to commonly eaten foods has been little exploited

The threat of victory

As in the case of iodine deficiency, the sustainability of vitamin A successes to date cannot be assumed. Supplementation programmes have shown themselves vulnerable to political turbulence in Africa and to economic recession in Asia.

Finally, there is now widespread concern that one public health success may soon fall victim to another. In many nations the outreach of vitamin A supplementation has been very significantly extended by the

07 Run of the mill

RAPID PROGRESS IN ADDING iodine to two-thirds of the world's household salt has fuelled hopes that the problem of iron deficiency might be tackled by adding iron to the world's flour.

For decades, fortified flour has put additional iron into the diets of the United States and Canada, providing about a quarter of daily iron intake.

Since 1995, the practice has spread to South America and the Caribbean and to several nations in the Middle East. More recently, Indonesia has taken a lead in Asia, and South Africa has begun adding iron, vitamin A, and other vitamins and minerals to wheat and maize flour.

UNICEF, the Micronutrient Initiative, and the Centers for Disease Control have long pressed the case for flour fortification worldwide. Now, with the growing realisation that even mild iron deficiency is more serious than anyone realised, a new urgency is building behind the campaign. *"During this decade,"* says Glen Maberly, Professor of International Health at Emory University and co-ordinator of the Flour Fortification Initiative (Panel 13), *"we would like to see the benefits of flour fortification extended to most places in the world where flour is milled on a large scale. It should become a matter of routine – normal good milling practice – legislated for by governments and expected by consumers. The costs are small, the risks negligible, the potential benefit to mankind enormous."*

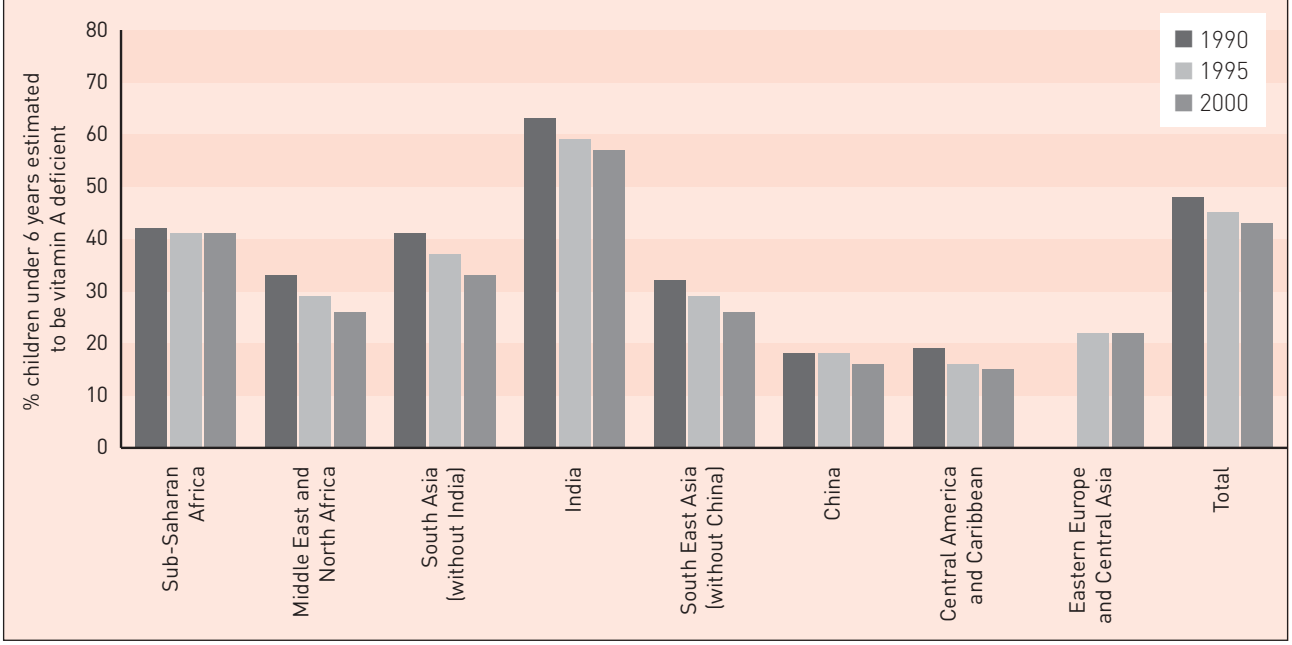
At present only 49 countries add iron to flour, representing about 15% of output from the world's flour mills. Almost 40 countries, including the US and Canada, also fortify flour with folic acid (Panel 8).

Fortification is not a total solution to iron deficiency. Unlike salt, flour is not a universal food. And where wheat flour is consumed, adding iron can only provide a proportion of daily requirements. In poorer flour-consuming countries it is possible that significant numbers of people may not be able to afford, or do not have access to, centrally milled flour. Only about 20% of the flour consumed in India, for example, is milled in large roller mills.

But it would be a mistake to assume that only the better-off would benefit. A large and increasing number of the world's poor, particularly in urban areas, also consume foods made from commercially-produced flour. And it is not only the poor who are iron deficient. Adding small amounts of iron to the daily diet would help to protect the many millions of people at all economic levels whose iron intake is barely adequate and who in times of stress – for example in pregnancy or in periods of rapid growth – are at risk of falling into severe deficiency.

Flour fortification is only one weapon, though a powerful one, in the struggle against VM deficiency. In the world's many flour-consuming countries it can be relied upon as a safe and effective way of raising overall levels of iron and folic acid in the national diet. ■

FIGURE 4
PREVALENCE OF SUB-CLINICAL VITAMIN A DEFICIENCY IN CHILDREN AGE 0-72 MONTHS, BY REGION, 1990-2000



Source: Mason, J. et al. The Micronutrient Database Project, Tulane University, New Orleans, LA, USA. Unpublished Data, 2003.

decision of many governments, following recommendations by WHO and UNICEF, to integrate vitamin A supplements into national immunisation days (NIDs). This has enabled the capsules to reach hundreds of millions of children. But with polio now close to eradication, the opportunity for vitamin A programmes to 'piggy-back' on mass vaccination campaigns is fast diminishing.

Some nations are attempting to compensate for this by replacing national polio vaccination days with 'vitamin and mineral days'. Others are attempting to boost the distribution of supplements through the regular health services. Nepal, for example, is mobilising thousands of community volunteers to maintain levels of coverage. Bangladesh is succeeding in reaching 90% of its young children by distributing vitamin A on national immunisation days, following this up six months later with a special 'vitamin A week'. But many nations do not yet have plans and budgets for maintaining vitamin A outreach once the vehicle of national immunisation days is no longer available.

The effort to eliminate vitamin A deficiency has therefore also reached a critical stage. Very significant progress has been made over the last 15 years, but there is now an obvious danger that the effort will stall well below the level required to protect those children most at risk (Panel 2).

There is therefore now a clear and crying need to use every possible means to identify and reach all children with the protection for life, growth and health that vitamin A affords. In the long run, vitamin A supplementation may be rendered redundant by food fortification, rising incomes, public education, and better diets; but in the short run more than 3,000 children are dying every day, and millions of survivors are growing up with frequent ill-health and poor growth, because the world has failed to provide them with vitamin A capsules that costs approximately 2 cents each.

Iron

'Very significant progress made, but job less than half done' might sum up the efforts of recent years to control deficiencies of iodine and vitamin A. But in the case of the third of the great trilogy of deficiencies – iron – there is a different story to tell.

The major advance against iron deficiency over the last decade has been in the scientific understanding of its scale and severity (Panel 5). But this new knowledge is still largely confined to researchers and sector professionals; its dreadful significance has yet to make itself felt among the leaders of political and civil society.

That iron deficiency reduces energy and productivity in adults is well known. That children who are iron deficient tend to be pale, weak, eat less, tire easily, are more irritable, have shorter attention spans, fall ill more frequently, and fail to grow as well as other children is also well established. For all of these reasons, iron deficiency has been categorised

08 The case for folate

MANY EXPERTS NOW ARGUE that folic acid, as well as iron, should be added to flour.

Deficiency in folate affects a majority of women and many men in virtually all countries. The consequences are thought to include an increased risk of heart disease and stroke. Initial research has suggested that as many as 25% of deaths from these two causes might be the result of folate deficiency. More conservative estimates put the increased risk at 10%. Some argue that a causal link has yet to be established.

What is not in doubt, however, is the link between folate deficiency and serious birth defects.

Folate enables cell division and tissue growth. If a woman is deficient in the very early stages of her pregnancy, bone and skin may not form correctly over the brain and spinal cord of the foetus; the result is a new-born child who is paralysed (spina bifida) or lacking part of the brain (anencephaly).

Without additional folate, approximately 2 in every 1,000 pregnancies end in the tragedy of these serious birth defects. With the higher folate levels achieved by adding folic acid to all flour, that rate could be halved. World-wide, that would mean approximately 125,000 serious birth defects prevented each year.

Since 1998, all flour in the United States has been fortified with folic acid in a concentration of 1.4 parts per million and in Canada of 1.5 parts per million. The result is a decline of 20% to 50% in spina bifida and anencephaly. Blood folate levels have increased and today there is virtually no folate deficiency anaemia in North America. In Chile, where folic acid has been added to flour in a higher concentration – 2.4 parts per million – the rate of serious birth defects has been halved. In the United Kingdom, a Committee on the Medical Aspects of Food has recently reported on the issue, recommending fortification of flour with folic acid.

While the investigation of the relationship between folate deficiency and heart disease continues, there is no reason to delay the deployment of folic acid against the tragedy of birth defects. Says Godfrey Oakley, Professor of Epidemiology at the Rollins School of Public Health, Emory University, Atlanta, and one of the leading proponents of fortification: *"there are more than 100 countries of the world where flour is regularly consumed by a significant proportion of the population. Adding folic acid to that flour is therefore an extraordinary opportunity to control a world-wide epidemic of tragic birth defects. Delay means only that more women will have unnecessary abortions, that more babies will be born with serious birth defects, and that many more adults will suffer unnecessarily from folate deficiency anemia."*. ■

Canada: folate and cancer

The incidence in one of the most common forms of childhood cancer has fallen by more than 60% since Canada began adding folic acid to flour.

Before fortification with folic acid, almost 16 in every 10,000 Canadian new-borns were victims of neuroblastoma, a cancer of the nervous system. Since that date, the rate has fallen to just over 6 per 10,000. *"It's the first time we've prevented a pediatric cancer with a very simple change to maternal diet,"* says researcher Gideon Koren of Toronto's Hospital for Sick Children.

Research by the hospital's *Motherisk* programme has also found that present levels of flour fortification are still not providing adequate protection. *"The typical Canadian woman is getting only 200 to 300 micrograms, well below the protection level,"* says Dr. Koren. *"It is perhaps time to consider raising the levels in flour"*

by WHO as one of the 'top ten' most serious health problems in the modern world.

But in the last 10 to 15 years, iron deficiency has assumed even greater importance as evidence accumulates linking iron deficiency with mental impairment. In various tests of cognitive and psycho-motor skills, for example, lack of iron has been found to be associated with significant levels of disadvantage – affecting IQ scores by as much as 5 to 7 IQ points.

At the same time, it has become clear that in most developing countries iron deficiency in young children is the rule rather than the exception. In one study of 31,000 children in 11 nations, more than 50% were found to be iron deficient in every monthly age cohort from 6 months to two years. Of the more than 80 countries for which the Micronutrient Initiative and UNICEF have prepared *Damage Assessment Reports*, the average prevalence of iron deficiency in children under five years old is approximately 45% (with 20 countries having prevalence rates of over 70% (Fig. 5)).

Nevin Scrimshaw, President of the International Nutrition Foundation and Senior Advisor to the UN University's Food and Nutrition Program, has spelt out the significance of these findings in stark terms:

"From 40 to 60% of the children in most developing countries are suffering from iron deficiency anaemia and nearly as many more have functionally significant iron deficiency. Prevalence rates are particularly high and devastating in their functional consequences for children aged 6 months to 2 years when the brain is continuing to grow. An increasing body of evidence shows that iron deficiency in infancy impairs brain development by mechanisms that include reduced myelination of cranial nerves and fewer dopamine neurotransmitter cells in the brain. The result is significantly lower I.Q. scores and behaviour problems that persist

FIGURE 5
COUNTRIES RANKED BY PERCENTAGE OF CHILDREN ESTIMATED TO BE IRON DEFICIENT, BY REGION, 2000

	Estimated prevalence of iron deficiency anaemia in children under 5 years (%)
South Asia	
Bangladesh	55
Pakistan	56
Afghanistan	65
Nepal	65
India	75
Bhutan	81
East Asia and Pacific	
China	8
Thailand	22
Philippines	29
Mongolia	37
Viet Nam	39
Indonesia	48
Myanmar	48
Lao PDR	54
Cambodia	63
Latin America and Caribbean	
Dominican Rep.	25
El Salvador	28
Honduras	34
Guatemala	34
Venezuela	41
Brazil	45
Nicaragua	47
Peru	50
Paraguay	52
Bolivia	59
Haiti	66
Eastern and Southern Africa	
South Africa	37
Botswana	37
Namibia	42
Swaziland	47
Lesotho	51
Zimbabwe	53
Kenya	60
Zambia	63
Uganda	64
Tanzania	65
Rwanda	69
Angola	72
Madagascar	73
Eritrea	75
Mozambique	80
Malawi	80
Burundi	82
Ethiopia	85
Western and Central Africa	
Gabon	43
Congo	55
Niger	57
Cameroon	58
Congo, Dem. Rep.	58
Liberia	69
Nigeria	69
Senegal	71
Togo	72
Mauritania	74
Central African Rep.	74
Gambia	75
Chad	76
Mali	77
Benin	82
Burkina Faso	83
Guinea-Bissau	83
Sierra Leone	86
Middle East and North Africa	
Lebanon	21
Egypt	31
Iran	32
Syria	40
Morocco	45
Yemen	59
Central and Eastern Europe and Newly Independent States	
Turkey	23
Armenia	24
Uzbekistan	33
Georgia	33
Azerbaijan	33
Turkmenistan	36
Kyrgyzstan	42
Tajikistan	45
Kazakhstan	49

Source: The Micronutrient Initiative and UNICEF. Data based on a global review of existing surveys of vitamin and mineral deficiencies, 2004

09 What's good for the rich

FOR DECADES the world's wealthiest nations have been fortifying common foods as a way of delivering essential vitamins and minerals to their populations:

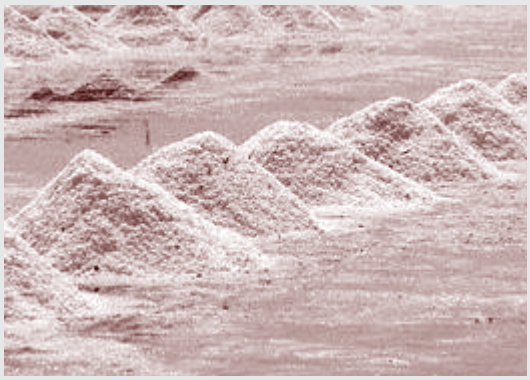
Iodine
The element iodine was discovered in 1811, but almost a century passed before it was established that lack of iodine caused the swelling of the thyroid gland commonly known as goitre.

Following research in 1921 showing that 90% of Zurich schoolchildren were suffering from goitre, the government of Switzerland become the first in the world to recommend iodine supplementation – either by weekly tablets or by consuming iodised salt. Similar studies revealed a 20% to 30% incidence of endemic goitre among schoolchildren in Austria, Northern Italy, and Germany.

In the United States, the alarm was first raised in Michigan in 1918 when it was revealed that over 30% of men medically examined for war service had been found to have an enlarged thyroid. Many were declared unfit for service. By 1923 an Iodised Salt Committee had been formed, including physicians and representatives of the Salt Producers Association.

On May 1st 1924 six local salt companies began loading iodised salt on the shelves of Michigan's grocers. Later that same year, the Morton salt company began marketing iodised table salt nation-wide under the headline *'Children protected against simple goiter are found to be superior in development'*. In Michigan itself newspaper adverts boosted sales, and by 1932 iodised salt accounted for 90% to 95% of all sales.

Meanwhile, Europe was also moving towards salt iodisation – swiftly controlling goitre, cretinism, and the milder forms of iodine deficiency. Illustrating the need to maintain vigilance, the problem now appears to be re-emerging in parts of Australia, Belgium, France, Germany, Italy, Poland, the Balkans, the Commonwealth of Independent States, and in the Central Asian Republics.



Common salt is consumed in small amounts almost every day by almost everybody, and is almost always bought from commercial sources – making it the ideal vehicle to carry added iodine.

Vitamin A
Vitamins also began to be added to foods in Europe and North America almost a century ago. Rickets was eliminated in many European countries and in North America by double-fortifying milk and margarine with vitamins A and D. About 25% to 50% of additional Vitamin A in the diet of the average European now comes from fortified food products.

Iron and B vitamins
In 1938, President Roosevelt signed into law a requirement that all US corn, wheat and rice products (including breakfast cereals) should be fortified with iron, thiamine, riboflavin, and niacin. As a result, conditions like pellagra (niacin deficiency) which had been causing approximately 3,000 deaths a year in the US, were gradually eliminated. Today, the fortification of flour provides the population of the United States and Canada with about a quarter of its daily iron intake.

Folic acid
More recently, the addition of folic acid to flour in the USA, Canada, and most Latin American and Caribbean nations, has begun to reduce serious birth defects like spina bifida. Research in Canada, China, and the United States is also indicating that fortifying flour with folic acid may significantly reduce cardio-vascular deaths in the over 50s. ■

and become even more significant in later childhood and adolescence.

"No country should allow such a massive, but preventable loss of mental capacity and no country can afford the impact of such loss on the effectiveness of educational investments and on the overall productivity of these children when they become adults in societies in which cognitive and social skills are becoming increasingly important for national development."

Losses

Unfortunately this new understanding of the problem has not yet been matched by any new commitment to finding a solution. *"Implementation strategies have not kept pace with the better scientific understanding of the disorder,"* says the *British Medical Journal*, *"and the gap between the necessary and the practical remains unbridged. There is no real prospect of a new generation of smarter, stronger children, replete with iron."*

Such pessimism is supported by Fig. 6, which presents an overview of trends in iron deficiency among the children of the developing world for the decade 1990-2000. With the exception of the People's Republic of China, there is very little progress to record.

Indeed so discouraging is this overall picture that the United Nations almost omitted to include the reduction of iron deficiency in its list of global development goals for the new millennium. Yet so severe is the problem that it could not be ignored, and the target was eventually set at a 30% reduction in iron deficiency by 2010.

The fact that a 'population-wide' reduction is being sought reflects the new understanding of the problem (previous targets had called for reductions in iron deficiency among pregnant women). But there is little to indicate that the new target will be achieved. The issue does not yet seem to have engaged the energies of national political leaderships or of the international community.

To some extent this is a problem of advocacy – of bringing to the attention of politicians, press, and public what is now known about iron deficiency and its consequences. To some extent, also, the problem may be that iron deficiency is seen as predominantly a 'women's issue' (Panel 6).

But in part, also, the relegation of the iron deficiency problem reflects the apparent lack of any obvious low-cost, large-scale solution.

As at 2004, there are signs that such solutions are beginning to emerge.

First, new and more easily absorbable iron supplements are coming on stream. Ferrous sulphate tablets have been used for many years and provide protection against iron deficiency for many millions of women. The tablets are inexpensive at less than 20 cents for a three month supply; but they must be taken daily or weekly, have an unpleasant taste, and may cause mild constipation. All this has limited the effectiveness of iron supplementation efforts. New forms of supplementation promise to boost the effectiveness and acceptability of such programmes. An Iron Deficiency Project Advisory Service (IDPAS) links a growing network of collaborators in over 100 countries to offer rapid transmission of advice and experience on these and other issues related to iron deficiency (Panel13).

Home fortification

There are also promising developments in fortifying foods with added iron.

First, the breakthrough may have been made in techniques for adding iron as well as iodine to common household salt (Panel 3). With the infrastructure for iodising two-thirds of the world's salt already in place, the possibility of including iron in existing salt fortification programmes has for some time been seen as the 'holy grail' of efforts to reduce iron deficiency. Following successful trials, India, Kenya and Nigeria are now moving into commercial production with the double-fortified 'Super Salt' that may soon be reducing levels of iron deficiency in whole populations.

Second, work is advanced on the development and testing of home-mix vitamins and mineral formulas that can be added during cooking or at the table. Whether packaged in tiny paper sachets similar to those commonly used for salt and pepper, or compressed into tablets that can be crumbled onto foods or dissolved in drinks, the idea of home-fortification promises a merger of supplementation, fortification and education. Most importantly, it holds out the possibility of addressing multiple deficiencies and adding iron, in particular, to the mashes and gruels commonly prepared for infants and young children. If given in addition to breast-milk, such home-fortified infant foods could bring substantial reductions in iron deficiency in the critical period between the ages of six months and two years (Panel 5).

Research continues, but attention is now turning to the challenge of developing home fortification products that are accessible, acceptable, and affordable to low-income communities.

Home-mixes are potentially an important breakthrough against VM deficiency in general and iron deficiency in particular. To exploit the potential, governments will need to give a clear lead in adapting home-fortification strategies to national needs and in educating the public to create demand. But extending the availability of home-based food fortification need not be seen as the exclusive responsibility of health services. Sachets of vitamin and minerals should be capable of being

10 Fortifying villages

THE MOST EFFECTIVE WAY of fortifying all flour products – from bread to bagels, tortilla to pasta – is to add a carefully measured mix of micronutrients at the stage where the flour itself is being milled from the grain. This is logistically easier if flour is produced in a few large roller-mills.

More than a third of Bangladeshi women are iron deficient, and almost 3,000 die each year as a result of severe anaemia in childbirth. Photograph: UNICEF, Maggie Murray-Lee

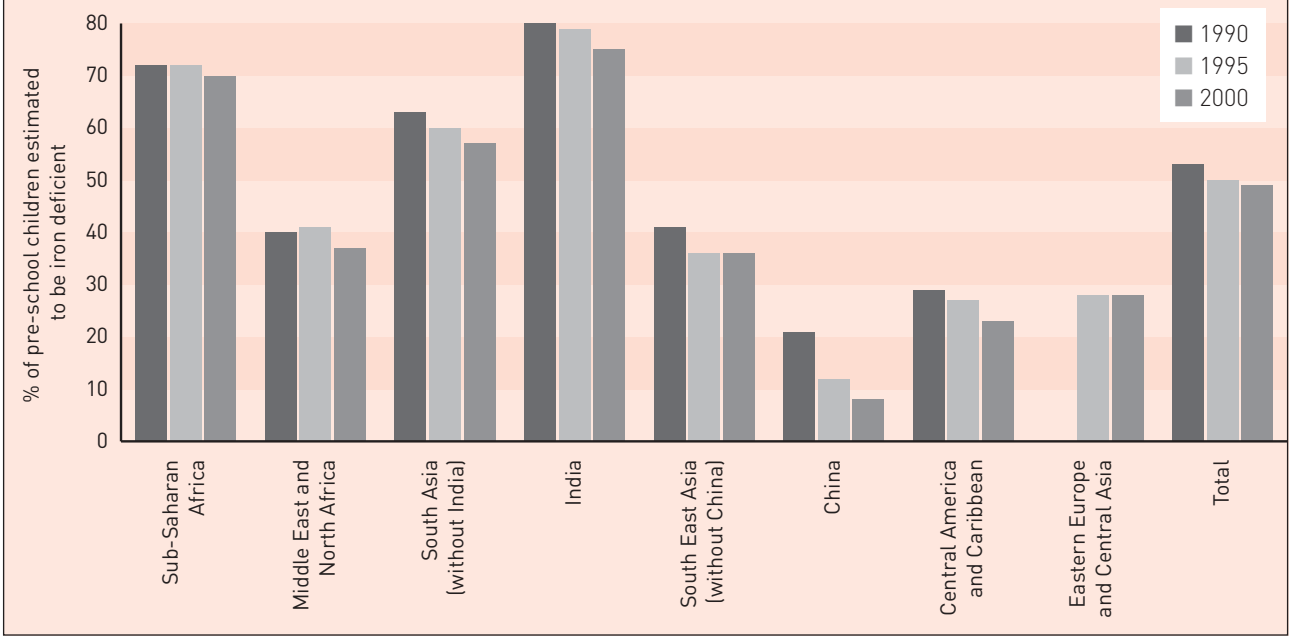
But in some countries, the kinds of foods that are made with commercially-produced flour may not be eaten by the poor. Local level fortification of food with essential vitamins and minerals is therefore a key issue if those in most need are not to be by-passed.

The Rome based United Nations World Food Programme (WFP) has taken a lead in trying to solve this problem by developing low-cost, local-level techniques of food fortification. One such initiative is the WFP-supported *Vulnerable Group Development Programme* which reaches out to half a million 'ultra-poor' women in rural areas of Bangladesh.

Finding that vitamin and mineral deficiency was prevalent among women involved in the programme, the WFP has been working with local NGOs, principally the *Bangladesh Rural Advancement Committee* and *Jagoran Chakra*, to fortify wheat flour locally. The programme, operating on a sustainable 'no loss, no profit' basis, uses four village-level hammer mills equipped with a new fail-safe device to prevent overdosing the flour with vitamins and minerals. Women from the *Vulnerable Group Development Programme* are employed to manage the mills. So far the mills are providing 28,000 very poor families with 25 kg. of fortified flour each month for a processing cost of approximately $20 per ton or $0.50 per 25 kg bag. A follow-up study by a major international research institute has confirmed an improvement in the vitamin A status of the communities concerned.

The WFP plans to expand the project to 40 small mills helping to meet the vitamin and mineral needs of even larger numbers of the country's rural poor. ■

FIGURE 6
PREVALENCE OF IRON DEFICIENCY IN PRE-SCHOOL CHILDREN, BY REGION, 1990-2000



Source: Mason, J. et al. The Micronutrient Database Project, Tulane University, New Orleans, LA, USA. Unpublished Data, 2003.

produced and distributed even more cheaply than the sachets of oral rehydration salts and condoms that now reach almost every village and neighbourhood in almost every nation. In other words, the potential of home-mix vitamins and minerals will be limited if it is seen as a medical responsibility rather than as a marketing challenge.

Fortifying staples

Thirdly, momentum is now beginning to build behind the movement to add iron to staple foods.

Adding iron to flour, in particular, has been shown to be a safe and inexpensive method of raising dietary intake of iron across whole populations in nations where flour is a significant part of the diet.

In some developing nations, too little flour is eaten for flour fortification to make a substantial difference (although flour consumption is rising world-wide and there are now over 100 nations where consumption exceeds 20kg per person per year). In others, a majority of flour is processed in small village mills which makes fortification logistically more difficult – but by no means impossible (Panel 10). Where flour is not eaten in significant quantities, other opportunities for adding iron to the daily diets of millions of people must be identified and exploited. This process has already begun – with iron being added to foods as diverse as noodle seasoning powders, soy sauce, and fish sauce. The Global Alliance for Improved Nutrition (GAIN) is attempting to accelerate this trend (Panel 13).

Food fortification therefore holds out the hope that the protection taken for granted by children in rich countries may soon be extended to the children of the developing world.

As at 2004, that hope is beginning to become a reality. Years of pressing the case for flour fortification by bodies like UNICEF, the Micronutrient Initiative, and the U.S. Centers for Disease Control are now beginning to move the process forward (Panel 7). In 1990 only two countries routinely added iron to flour. Today the number is almost 50 – including many countries of Central and South America and the Middle East, plus Indonesia, Nigeria and South Africa. In 2003, GAIN began funding plans to implement flour fortification in a number of new countries. China has now received the first GAIN grant of $6 million to begin fortification of wheat flour and soy sauce with iron.

Meanwhile the leaders of some of the world's largest wheat milling and trading concerns have backed the Flour Fortification Initiative (Panel 7). In 2002 the International Association of Operative Millers, in endorsing flour fortification, accepted responsibility for co-ordinating training and technical support in milling schools. The Australian Wheat Board, a major grain supplier, is now offering to assist this process by supplying a high quality iron pre-mix free with wheat exports to iron-deficient countries.

Promising as these developments are, it is important to remember that the fortification of flour or other foods cannot provide more than a proportion of the individual's daily need for iron. But it can reduce the

11 FAQs

Why not just educate people about what foods to eat?

Why bother with fortification and supplements which only make people dependent on unreliable and distant services? Why not empower them with information to get the vitamins and minerals they need from locally available foods?

Even in the industrialised nations with their higher incomes and literacy rates, several decades of providing people with information through schools, health services and the mass media have often failed to have the hoped for impact.

In an ideal world, people would have the choice of whether or not to use fortified flour or iodised salt. But in the real world, this is likely to mean that only the better-off and better-educated enjoy the benefits.

In Australia, for example, a social marketing campaign has persuaded only about a third of women to take folic acid supplements. In the US, fewer than 20% of women are aware of the benefits of folic acid. In Canada, the proportion of women planning to have a child who know that they should be taking a folic acid supplement is less than 5%. Meanwhile, many millions of children are being born and growing up with unnecessary mental and physical impairments.

Empowering people with information about how to protect themselves and their families against vitamin and mineral deficiency is a policy that should be pursued in every country. But on its own it will not solve the VM deficiency problem.

Is food fortification safe?

Isn't it dangerous to start adding things to staple foods? What about side effects? Will we only discover the dangers later?

The fortification of food with minerals and vitamins has a long and safe history in the industrialised nations. Almost the entire population of the United States, Canada, and many European countries has been consuming fortified foods for half a century or more.

What if people take too much?

If different food manufacturers start adding vitamins and minerals to different foods, isn't there a danger of overdosing?

All food fortification needs to be carefully regulated, and the amount of vitamins and minerals added to a specific food is usually set at a proportion of the individual's daily requirement (usually less than a third).

Why not just legislate?

If the problem can be solved by adding vitamins and minerals to food, why doesn't the government just make it compulsory?

Legislation is a strong message that shows a governments commitment to the fortification of foods. But it is not the whole answer. Take, for example, the challenge of adding iodine to salt in Pakistan. There are almost 600 small salt producers, many of them in remote areas and using age-old methods of crushing and grinding rock-salt. All of them have to be contacted with explanations, training, assistance, start-up finance, regular supplies of an iodine compound, and perhaps help with packing and storage. Thereafter the law has to monitored, and if necessary enforced. The same is true for the many thousands of small flour millers in the developing world.

In the case of food fortification programmes it will also often be the case that the poorest communities do not regularly consume the kind of industrially processed staples that are suitable for fortification.

Finally, it must be recognised that in some countries the law may simply not be well enough respected or enforced.

For all of these reasons, legislation alone will not be enough. It needs to be backed up by advocacy, education, monitoring, and enforcement. ■

size of the task. As one of a range of strategies, deployed simultaneously, it is an efficient and sustainable way to put a daily dose of iron into the diets of hundreds of millions of people at very low cost. It can therefore play a major part in moving the world towards the goal of reducing iron deficiency by 30% or more by 2010.

In sum, it is now known that iron deficiency brings the kind of damage that no government should tolerate. New knowledge about the scale and consequence of the problem needs to be made more widely known; and national leaderships must be made aware that this what is at stake is protection for the lives, brains, bodies and energies of between a quarter and half of their populations.

The means are now becoming available to bring iron deficiency under control at an affordable cost.

But it is essential that emerging technical solutions are quickly translated into new political commitments. The story of the last decade has been one of the gains made in understanding the real nature and extent of the problem; the story of the next decade must be one of the gains made in developing and deploying the solutions.

PART 3
THE CHALLENGES FOR 2004-2010

Knowledge about the nature and scale of micronutrient deficiencies is constantly expanding. The consequences of folate deficiency, for example, are becoming better understood with each passing year (Panel 8). Similarly, mild-to-moderate deficiency of the mineral zinc is now thought to affect approximately a third of the world's population (Panel 13). And in many parts of the world, significant numbers of people are also affected by deficiencies in selenium, vitamin D and B vitamins.

All such advances in knowledge of the VM deficiency problem strengthen the case for integrated and comprehensive approaches, not only because populations are commonly victims of multiple deficiencies but also because interactions between micronutrients mean that a lack of one may inhibit the body's ability to absorb another. But while research must continue, it is also essential that the issue does not become trapped in its own complexities. The most important priority for the decade ahead is to develop national political commitments to find and fund the ways and means to put known solutions into action on the same scale as the known problems.

What now stands in the way? And what are the lessons of the last decade that can guide the efforts of the next?

The challenge of integrated solutions

A first clear lesson and challenge to be drawn from the experience of the last 10 years is that each of the possible solutions to the problem of VM deficiency is capable of making a major contribution but that none is capable of doing the job on its own. Success in the decade ahead is therefore likely to depend on deploying not just one solution but different combinations of available and known-to-be-effective methods.

The limitations of food fortification have already been discussed. Supplementation programmes, when integrated into existing health services, may not reach all those in need. Specially set up programmes aiming to reach everybody in a given target group, on the other hand, may prove difficult to sustain when the initial enthusiasm wanes and when the problem itself is no longer apparent. And even empowering families with information to improve diets can be only a partial solution; in the world's industrialised nations, with their high incomes and advanced communications capacities, efforts to empower people with knowledge about healthier diets have met with only limited success. Nor can long-term economic development and rising incomes be relied upon to eliminate VM deficiency. The children of many millions of high-income families in North America today would not have adequate iron were it not for the fact that infant foods and all cereals are fortified. Similarly, many in Europe would lack iodine, vitamin A, and other essential micronutrients were

12 A GAIN for world nutrition

A NEW GLOBAL ALLIANCE for Improved Nutrition (GAIN) headquartered in Geneva, Switzerland, has joined the struggle to eliminate vitamin and mineral deficiencies world-wide.

At the centre of the GAIN strategy is the idea of *National Fortification Alliances* bringing together governments, food companies, health and nutrition specialists, non-governmental organisations, and relevant UN agencies to analyse the problems and press for solutions. Acting as a channel for making available world-wide contacts and resources, GAIN will assist *National Fortification Alliances* in the drawing up detailed plans of action embracing the full range of possible approaches to the vitamin and mineral deficiency problem. The resulting plans will then be considered by GAIN for possible funding.

In particular, the new organisation aims to develop and exploit the possibilities of food fortification world-wide. Adding vitamins and minerals to commonly consumed foods is seen as a safe, effective, inexpensive and sustainable way of raising the vitamin and mineral status of a significant proportion of the population. By reducing the scale of the problem, it can allow other strategies such as the distribution of vitamin and mineral supplements, to be more cheaply and sustainably focused on particularly vulnerable groups.

The new organisation also stands ready to link national initiatives to international experience – including facilitating access to technology, training, and private sector expertise. It will advise on international standards and quality control, assist with plans for improving 'complementary' feeding of very young children, and help develop agreements for the ethical marketing of fortified foods.

GAIN is now in the process of funding its first two rounds of food fortification proposals submitted by *National Fortification Alliances* in 10 countries. Over the next four years, the organisation's other aims include developing a global strategy for the production and responsible marketing of fortified complementary infant foods (for those aged 6 to 24 months). GAIN is also undertaking a major piece of research to analyse the costs of ending VM deficiency world-wide. The organisation will also play its part in communicating what is now known about vitamin and mineral deficiency and advocating action by governments and the international community.

GAIN is currently funded by a grant of $50 million from the Bill and Melinda Gates Foundation, and a further $20 million from the Micronutrient Initiative and the official aid programmes of Canada, Germany, the Netherlands, and the United States. ■

they not added to salt, infant foods, milk, or margarine.

Each of the potential solutions is therefore a necessary but insufficient contribution. Each may address a different deficiency, or provide a fraction of the vitamins and minerals required, or be relevant to a specific target group, or operate on a different time scale, or be more or less difficult to finance and sustain, or be the responsibility of a different institution. In the past this has sometimes meant that efforts to confront VM deficiency have been fragmented and piecemeal, relevant to many departments of government but the responsibility of none. To accelerate progress towards the goals, the whole range of available solutions will need to be deployed not as sporadic, stand-alone efforts but as part of a well-knit plan driven by the consistent vision of reducing vitamin and mineral deficiency across entire populations.

The challenge of national partnerships

A second fundamental challenge of the years ahead is the challenge of creating alliances within each nation to press for, plan, implement and monitor the practical, detailed, national solutions to problems of vitamin and mineral deficiency.

Experience to date suggests that such alliances – whether formally or informally constituted – are most effective when they represent the full range of those who have the expertise, authority, and means to put particular solutions into effect on a national scale. They need to embrace, for example, not only government departments but universities and researchers, health and education professionals, food and pharmaceutical companies, consumer associations and non-governmental organisations. Where possible all of these potential partners need to be involved from an early stage so that ownership of the initiative is shared and so that the plans and standards adopted will be more realistic and more willingly and quickly accepted.

Once constituted, such alliances can help to translate scientific findings and globally advocated strategies into the practicalities of need, opportunity, and difficulty in each country. They can help to advocate solutions like food fortification in ways that engender public trust, and they can act as a focal point for international expertise and assistance. They are the essential 'missing link' between problem and solution.

It might be asked 'Why not government?', and indeed the control of vitamin and mineral deficiencies is ultimately a government responsibility. But governments come and go, and the sails of priorities are trimmed to prevailing political winds. National alliances of interested and committed individuals and organisations, on the other hand, can maintain the pressure and momentum year after year. In particular, such alliances can help to ensure that advocacy is not a one-off exercise but a sustained attempt to secure, and periodically renew, political commitment.

In some countries, governments have taken a dynamic lead. But there are also examples of the lead being taken by the private sector, by individual politicians, by flour-millers, by international agencies, by public health officials, and by the academic and research community. Often, a single individual has been able to successfully champion the cause of, for example, flour fortification at national level. But ultimately the aim of all who champion the VM deficiency cause must be for government to accept responsibility for bringing the problem under control on a nation-wide scale. Only government can adopt and enforce the necessary regulations and standards; only government can mobilise the resources (including the necessary international assistance) to go to scale with whatever mix of solutions and investments is judged practical in the national context; and only government can take on the responsibility to legislate and enforce, to remove barriers and change tax laws, to set standards and create the framework within which the resources and skills of the private sector can be brought to bear on the problem. In particular it is the clear responsibility of government – particularly through education and health services – to educate consumers. Commercial messages can help; but a clear message from government is also necessary to lend credibility to, and build public trust in, the VM deficiency message. But wherever possible it makes sense for government to encourage the private sector (see below) and non-governmental organisations to take the lead in specific strategies such as food fortification. Apart from the obvious broadening of the effort, this also means that government can concentrate more of its energy and resources on identifying and reaching the poorest or most remote populations who might otherwise be excluded from protection.

The challenge to the private sector

Third, there is the challenge of creating the conditions under which the private sector will decide to address the VM deficiency problem.

It is the private sector that can produce, promote, and distribute fortified foods to whole populations. And it is the private sector that has the proven track record of 'reaching the unreached' with everything from cigarettes and soft drinks to condoms and lottery tickets. It has already been noted that success will remain limited for as long as solutions are seen exclusively in terms of outreach and coverage through government channels. The problem needs to be seen not only in

13 Advice network

The MI website (www.micronutrient.org) acts as a gateway to sources of further information and to other organisations working to combat vitamin and mineral deficiency. The following are examples of international organisations that can be contacted for further information on particular aspects of the VM deficiency problem and its potential solutions.

Iron

Through the International Nutrition Foundation, the United Nations University and the Micronutrient Initiative have established an Iron Deficiency Project Advisory Service (IDPAS).

The IDPAS service links up those working on iron deficiency problems in over 70 countries. Through its web-site and a growing network of collaborators in over 100 countries , the service offers rapid transmission of knowledge and experience on all matters concerning iron deficiency assessment, control and prevention. Available to all policy makers and practitioners, this multi-disciplinary information service provides over 2,200 references, many including the full text, dealing with all aspects of iron deficiency. IDPAS aims to respond within 48 hours to requests for information and advice. *www.micronutrient.org/idpas*

Flour Fortification

The Flour Fortification Initiative (FFI) campaigns for the global fortification of flour with iron and folic acid by making known the consequences of iron and folate deficiencies and the potential benefits of low-cost fortification. As a public-private partnership, FFI seeks to bring together growers, sellers, millers and users of flour. It encourages them to become partners in food fortification and, where necessary, to take the lead. *"Success can only come,"* says Dr. Glen Maberly of Emory University, co-ordinator of FFI, *"from having the wheat and flour industry organisations adopt this initiative as their own"*.

FFI also offers an information clearing house, technical support and training, and education and advocacy materials. *www.sph.emory.edu/wheatflour/Main.htm*

Zinc

Suspicion has been growing that the lack of another mineral – zinc – may be a major cause of ill health and poor growth. Analysis of several community-based trials has suggested that zinc supplementation can reduce the prevalence of diarrhoeal disease by 20% and of pneumonia by as much as 40%. These two diseases are responsible for approximately 40% of all child deaths in the world each year.

There is also considerable evidence that children who are stunted respond to zinc supplements by putting on weight and height, suggesting that zinc deficiency may be partly responsible for stunting.

Larger-scale studies of the potential of zinc supplementation are now underway in several countries.

Although there are few national surveys to draw upon, best estimates suggest that a third of world's population live in countries at high risk of zinc deficiency. The International Zinc Nutrition Consultative Group recommends that all such 'at-risk' countries begin monitoring the problem and investigating solutions.

As with other vitamin and mineral deficiencies, possible solutions include promoting better diets and feeding practices, the distribution of zinc supplements, and the fortifying of staple foods and condiments.

The International Zinc Nutrition Consultative Group (IZiNCG) is a non-profit, voluntary organisation appointed by the United Nations University and the International Union of Nutrition Scientists to promote and assist a global effort to reduce zinc deficiency, particularly in low-income countries. Further information is available from the Group's web-site *www.izincg.ucdavis.edu/default.html* ■

epidemiological terms but in marketing terms; not only as a public sector responsibility but as a private sector opportunity.

Why should the private sector bother? There is as yet little demand for fortified foods, home-mixes, or supplements. And those in most need are, by and large, those with little purchasing power.

The short answer is that the private sector is unlikely to take on the VM deficiency challenge unless governments step in to change the terms of the commercial equation.

Governments can tilt the balance in a number of ways. First, there is legislation – for example making the fortification of certain foods compulsory. If such legislation is discussed with the industry, if it is applied uniformly and transparently with penalties for non-compliance, and if the guidelines are stable and consistent, then most companies are likely to accept this as a level playing field and to respond positively.

Government can also intervene directly to reduce the costs and risks for companies contemplating the challenge of VM deficiency. In particular, public-private partnerships can make it viable for food companies to invest in developing and marketing fortified products aimed at reaching the poor.

For example governments can:

- Build public demand through sustained public information campaigns using health and education services as well and print and broadcast media.
- Assist with start-up finance, capital purchases, technical training, product development, consumer testing, and marketing costs.
- Subsidise the fortification of foods that are specifically targeted at low income groups or used in public health programmes.
- Endorse approved food products, with official seals or stamps for use in advertising.
- Consider allowing distribution of fortified infant foods via government channels such as schools, hospitals, and clinics.
- Specify fortified foods when placing commercial food orders for school meals services and food for the armed forces.
- Reduce duties on imported vitamins and minerals or on essential machinery and pre-mixes for flour fortification.
- Purchase supplies of vitamins and minerals using foreign exchange provided under aid programmes.
- Provide storage and release vitamins and minerals to the private sector as and when needed – at or below cost price.

The kinds of agreements made are likely to involve a complex and nationally-specific mix of nutritional, social, legal, and commercial considerations negotiated between government, nutritionists, and food industry representatives. To avoid such negotiations running into the sands of bureaucracy, mutual suspicion, and impatience, channels of communication need to be kept open. In many cases it will help to appoint a mutually agreed sponsoring organisation or individual who commands respect from both sides. A well-respected 'champion' of food fortification, or of the broader struggle against vitamin and mineral deficiency, may well be crucial to success.

The details of public-private partnership arrangements will vary with the very different business environments in each nation. But the constant is the need to find ways of making it feasible and profitable for business to co-operate, invest, and innovate in finding solutions to vitamin and mineral deficiency. *"Unless there is an enabling environment for the private sector to improve dietary quality through market-based solutions,"* says former Asian Development Bank adviser Christine Wallich , *"the problem will persist."*

The challenge of research and development

Controlling VM deficiency also poses clear and urgent challenges to the scientific and research community.

It is frequently said that the nations that have succeeded in bringing VM deficiency under control did so with less knowledge and technology than is available today. But those nations usually had the advantages of higher incomes, better diets, and more developed health services. It is true that the central challenge is to put already available solutions into action, but further research and development could accelerate that process by offering solutions that are more capable of being put into practice on a large scale and at low cost.

Research and development is needed, for example, to enhance the outreach and effectiveness of the supplements on which current efforts so heavily depend. For the foreseeable future, vitamins and minerals in the form of capsules, tablets or syrups will continue to play a key part in protecting populations at particularly vulnerable stages in the life cycle – early childhood, adolescence, and pregnancy. The development of multi-vitamin and mineral tablets that can be administered less often, at less cost, and with higher acceptability, could ease the logistical and financial problems associated with this most immediate of strategies for addressing the problem.

Another important research priority, already touched upon, is the development of a variety of vitamin and mineral mixes which can be successfully added to food in the home – whether in the form of powders or tablets that can be sprinkled, crumbled, or dissolved. Such 'home-fortification' products need to be safe, stable, easy to use,

14 A global partnership...

The following is an edited version of the speech delivered by Kul Gautam, Deputy Executive Director of UNICEF, to the International Grain Council Conference in London, June 25th 2003

At first, it might seem odd that a UN official – especially a representative of UNICEF, the United Nations Children's Fund – should be addressing this gathering of the world's major grain producers, millers, exporters and importers.

In fact, I am here to try to convince you that if we combine our efforts, we can make an extraordinary impact in the global fight against poverty, illiteracy, diseases and malnutrition in ways that few of us have imagined possible.

This is a large claim. Let me try to give it substance.

Hidden hunger

As well as proteins and calories, the human body needs very small quantities of key vitamins and minerals – such as iodine, vitamin A, iron, folic acid and zinc. Because the quantities needed are so small, they are sometimes called micronutrients. But let the term micro not mislead us; for they are indeed worthy of being called super-nutrients.

The lack of these essential vitamins and minerals affects more than a third of the world's people. It means that two billion men, women and children, mostly in the developing countries, suffer from a subtle and insidious 'hidden hunger'. It is not the kind of hunger that you feel in the belly but the kind that strikes at the core of your health and vitality. It can cause blindness and brain damage. It can induce stillbirths and abortions. It make people fatigued and lethargic. It can make killers of ordinary childhood diseases such as diarrhoea, malaria and measles. It contributes to high rates of maternal and child deaths. It can render investment in education less effective as children are unable to concentrate on their studies.

Further, the economic losses attributable to micronutrient deficiencies are huge.

Silently, invisibly, micronutrient deficiencies trap people, communities and entire countries in a cycle of poor health, poor educability, poor productivity and consequent poverty, often without the victims ever knowing the cause.

How the grain industry can help

The relevance of all this to the International Grain Council is that the industry today delivers more food to more people in more parts of the world than ever before. And it is therefore in a position to help end micronutrient deficiency by fortifying cereal flours with essential vitamins and minerals.

In particular, the fortification of flour can help to rid the world of the scourge of iron deficiency which affects as many as half of all the women and children of the developing world and brings incalculable losses in well-being and productivity. Indeed, eliminating iron deficiency can do more than any other single programme to achieve human development goals.

Fortifying flour with another micronutrient – folic acid – can also help to prevent more than 125,000 severe birth defects every year – including spina bifida. We have seen dramatic evidence of this effect in the USA and Canada which mandated folic acid fortification in the late 1990s. Birth defects in USA and Canada have since fallen by between 20% and 50%.

Such evidence provides not only a health and economic justification, but a moral imperative for action.

Fortification

Let me try to outline how it would be possible for organisations like the International Grain Council, the United Nations, and other partners to make a significant impact in combating this pervasive hidden hunger.

Let us recall that over the past half a century, fortification of flour and other cereals has played a major role in delivering essential vitamins and minerals to consumers in the industrialised countries. This has helped eliminate nutritional deficiencies and contributed immensely to improving health and reducing death and disease.

Flour is a food staple in more than 180 countries. The major flour producers, many of whom are represented here, therefore have the power to offer this same protection to millions of consumers around the world by

continued on page 32 >

taste-free, easily absorbed into the body, and above all massively cheap to manufacture, package, and market. Once again, public-private partnerships are likely to be essential if 'home-fortification' is to become as normal and as cheap as adding pepper or salt or other condiments.

The potential of commercial food fortification could also be boosted by research into the foods that are most suitable for fortification in each country. Further refinement of the form in which nutrients are added could also increase effectiveness and reduce costs (for example improved iron pre-mixes for flour fortification).

Work is also in progress to develop ways of fortifying rice with granulated pre-mixes of vitamins and minerals. If this can be done cheaply, and without affecting taste, smell, price or ease of preparation, then it would also be a breakthrough of great significance. The rice-and-vegetable diets of billions of people cannot usually provide adequate vitamins and minerals in forms that are sufficiently well-absorbed by the human body. Many vegetables and fruits do contain the beta-carotene that the human body converts into vitamin A, for example, but the conversion ratio is very much lower than was previously believed – so low in fact that it is almost impossible for a young child to consume enough fruit and vegetables to meet his or her vitamin A needs. In the absence of meat, eggs and other dairy products, vitamin A deficiency will continue to affect billions of people, particularly in Asia, unless supplementation and fortification can bridge the gap. The addition of vitamin A to rice, if it can be achieved on the necessary scale, would therefore represent a major advance.

The bio-fortification of other commonly consumed foods such as maize, millet, sorghum, yams, beans, cassava, sweet potatoes, bananas, cowpeas, groundnuts, and lentils, is also a potentially powerful weapon against VM deficiency. Research and development on bio-fortification by both conventional plant-breeding methods and the more controversial genetic splicing techniques is already underway in centres such as the International Rice Research Institute in the Philippines, the International Maize and Wheat Improvement Centre in Mexico, the International Potato Centre in Peru, and the International Centre for Tropical Agriculture in Colombia.

Significant new funding has been committed for this research by the Bill and Melinda Gates Foundation, Danish International Development Assistance (DANIDA), USAID and others. As a result, bio-fortified foods could be on the market within the next ten years. Populations with limited access to supplements or commercially marketed foods could be the principal beneficiaries.

Meantime, the task is to move ahead with the tools that are to hand.

Finally, the potential for research into more effective ways of educating consumers and changing diets should not be ignored (Panels 1 and 4). Persuading people to consume a greater variety of foods, or to demand fortified products like salt, sugar, or margarine, or to take regular iron supplements – is a notoriously difficult task. Simply telling people that something is good for them is rarely enough on its own – whether in rich countries or in poor. Again and again experience has shown that bringing about behavioural change depends on building on currently existing knowledge rather than taking a 'blank slate' approach, and must concentrate on enhancing the desirability of the product while simultaneously making it accessible and affordable.

The challenge of monitoring

If progress against VM deficiency is to be accelerated, then it will also be important to have more accurate and timely data on the prevalence of the problem and on the progress being made against it. The national *Damage Assessment Reports* and *National Protection Audits* currently being produced by the Micronutrient Initiative and UNICEF have brought together the best available data on VM deficiency for each individual country. But these data are not nearly good enough. In some countries, they are based on partial surveys, extrapolations, and statistical modelling techniques which attempt to make up for the lack of accurate and up-to-date national data.

Better monitoring is essential for informing policy, providing feedback on what works, making government departments more accountable, and providing practical guidance and encouragement to all those involved in combating VM deficiency. More timely data would also be a clear sign that government is alert to the importance of the issue. Almost all developing nations can and do produce quarterly or annual data sets on the growth of their economies and exports, and on the numbers of computers and cars being imported; but very few are generating even five-yearly statistics on the proportion of children who are malnourished, or who lack the vitamins and minerals that an enable their bodies and brains to grow to their full potential.

The challenge of advocacy

Better data is also essential for better advocacy. And it is this task – the task of creating the essential catalyst of widespread knowledge and concern – that is perhaps most urgent of all.

VM deficiency is an issue which has been preserved in the amber of a pre-1990 era; a problem to be dealt with by health professionals reaching out to those with clinical symptoms of deficiency. For as long as the problem is seen in this way it will not engage the concern of national

...to end hidden hunger

> continued from page 30

supporting the fortification of cereal flours with essential micronutrients.

The benefit of expanding flour fortification world-wide is clear. The technology is simple. The cost is pennies per metric ton. And the good news is that millers in about 30 countries are already fortifying their flour with one or more of these essential vitamins and minerals.

The time has therefore now come to support and expand flour fortification with essential micronutrients globally – through a strong collaboration between the grain and flour industry, governments, UN agencies and other partners.

Specific action

What, specifically, do we want the grain and milling industry to do?

We would urge the grain industry to become an active partner in making flour fortification – with iron and folic acid – a reality in developing countries. We would like to see fortification integrated into all existing large and medium mills. We would ask you to dramatically expand the production of fortified flours.

We want you to share your technical expertise and help transfer technology to the developing world. We would like to see your production, distribution and marketing skills applied to make flour and cereals fortified with iron and folic acid widely available to deficient populations in developing countries.

We are not asking you to do this alone. UN organisations like UNICEF, WHO, FAO, WFP, UNDP and the World Bank would be happy to partner you. Non-governmental organisations such as the Micronutrient Initiative (MI) and the Global Alliance for Improved Nutrition (GAIN) and a number of university-based institutions are eager to work you. We have the strong commitment of major bilateral donors such as the Canadian and US aid programmes, and the Centers for Disease Control, and others who are willing to be your partners in this effort.

Win-win

We believe that now, as the milling industry modernises and consolidates, as technology exchange and transfer proliferates, as changing food consumption patterns give more people access to centrally processed foods, the time has never been more right for an initiative aimed at fortifying all flour with essential micronutrients, especially iron and folic acid.

I believe this can be a 'win-win' proposition. For the UN, it enables us to reach those who need help in achieving internationally agreed development goals. For you, it helps to enhance your products in the market place and your image as good global corporate citizens.

During this decade we would like to see the benefits of cereal flour fortification expanded from a few countries to the whole world. To achieve this goal, governments will need to adopt supportive policies, legislation and regulatory practices. And the grain trade and milling industry will need to adopt fortification as a global norm.

I hope every one of you will join us in the greatest challenge confronting humanity today – the fight against poverty, illiteracy, ill health and malnutrition – so essential to create a world fit for our children. ■

political leaderships or generate the kind of population-wide interventions that are needed. *"Even today,"* says Rolf Carriere, Executive Director of GAIN, *"the impact on a nation's economy is virtually unknown among government leaders, politicians and economists, even as it traps people, communities, and entire countries in the cycle of poor health, poor educability, poor productivity, and persistent poverty."*

If goals for reducing vitamin and mineral deficiency are to be met, then the next twelve months must be used to bring a new public and political awareness of the scale and consequence of the problem. Vitamin A deficiency must no longer be seen as a condition that causes blindness in a small minority but as a plague that claims a quarter of all child deaths. Iodine deficiency must be seen not as a condition that causes some people to have an unsightly swelling at the throat, but as the world's most important cause of mental retardation. Iron deficiency must no longer be perceived only as a problem that causes tiredness in pregnancy but as an assault on the mental and physical development of a significant proportion of the rising generation. And VM deficiency as a whole needs to be seen by a nation's political leaders as a problem with profound consequences for almost every aspect of national life including health, education, employment, productivity, and growth.

Changing the image of VM deficiency involves marshalling the facts on its extent and causes. Thereafter it is a task of keeping the issue in front of politicians, press and public – a task of asking questions and demanding answers of national leadership. Do national political leaders know what proportion of the nation's children are growing up below their mental and physical potential and why? Or how many adults have significantly lowered productivity? Or whether the nation's staple foods are fortified and its salt iodised? Or whether vitamin and mineral supplements are reaching the children and women most at risk?

All organised resources can become involved in the task of making the facts known and up-dating national awareness of VM deficiency – including health and nutrition specialists, journalists and broadcasters, teachers and educationalists, academics and researchers, corporate heads and trade unionists, professional organisations and food corporations, non-governmental organisations and consumer groups, religious leaders and those influential in civil society.

One-off advocacy campaigns will not suffice. Within a very few years the action needed to control VM deficiency must become part of the normal fabric of national life throughout the developing world – a habit in government policies, in health service protocols, in industry standards, and in consumer preferences. But until that day comes, there is a need for several years of sustained pressure and vigilance.

Conclusion

As this *Global Progress Report* has shown, recent years have seen some remarkable achievements and witnessed substantial progress in the struggle against VM deficiency. But there are some signs that the momentum may be slowing as the path steepens.

Over the next few years, it is essential that the momentum be maintained and protection extended to the poorest families and communities. Any complacency about past achievements, any creeping sense that 60% or 70% is good enough, will result in vitamin and mineral deficiency gradually becoming a problem only for the poor. And experience in many fields has shown that this will make it significantly more difficult to mobilise the political commitment and financial resources to put even low-cost solutions into effect. It is now, when VM deficiency can fairly be said to be a national and population-wide problem, that action needs to be taken to put in place the policies and interventions that will sustainably protect entire populations.

After a decade of dramatic developments, the facts are known, the solutions are available, and the cause is one in which many individuals and organisations – governments, the private sector, the medical and scientific community, civil society – can become involved. The challenge is therefore clear. And when so much could be achieved for so many and for so little, it would be a matter of global disgrace if vitamin and mineral deficiency were not brought under control in the years immediately ahead. ■

VM DEFICIENCY

National Damage Assessments Reports
National Protection Audits

The Micronutrient Initiative and UNICEF have issued *Damage Assessment Reports* for 80 countries with significant VM deficiency. These nation-by-nation alerts draw on latest available data to present the most comprehensive picture to date of the toll being taken by VM deficiency in each country. Where possible, *National Protection Audits* have also been drawn up to monitor the action being taken.

The following pages provide a summary of the findings for the 80 countries – covering approximately 80% of the world's population.

Information is in some cases based on partial surveys and statistical modelling techniques which attempt to make up for the lack of accurate and up-to-date national data. More accurate and timely monitoring is essential for informing policy and advocacy. Improved data collection would also be a clear sign that government is alert to the importance of the issue.

VM DEFICIENCY: NATIONAL DAMAGE ASSESSMENTS

	IRON DEFICIENCY			IODINE DEFICIENCY		VITAMIN A DEFICIENCY	
	Estimated prevalence of iron deficiency anaemia in children under 5 years (%)	Estimated prevalence of iron deficiency anaemia in women age 15-49 (%)	Estimated annual no. of maternal deaths from severe anaemia	Estimated annual no. of children born mentally impaired	Total Goitre Rate (%)	Estimated annual no. of child deaths precipitated	Estimated % of children under 6 with sub-clinical vitamin A deficiency
Afghanistan	65	61	2,600	535,000	48	50,000	53
Angola	72	59	-	235,000	33	34,000	55
Armenia	24	12	<100	3,500	12	<100	12
Azerbaijan	33	35	<100	22,000	15	1,100	23
Bangladesh	55	36	2,800	750,000	18	28,000	28
Benin	82	65	380	10,000	<5	9,000	70
Bhutan	81	55	<100	-	-	600	32
Bolivia	59	30	120	13,000	<5	1,200	23
Botswana	37	31	<100	9,000	17	500	30
Brazil	45	21	880	50,000	<5	4,000	15
Burkina Faso	83	48	490	180,000	29	20,000	46
Burundi	82	60	-	125,000	42	8,500	44
Cambodia	63	58	520	85,000	18	8,000	42
Cameroon	58	32	360	65,000	12	10,500	36
Central African Rep.	74	49	250	16,000	11	5,000	68
Chad	76	56	550	100,000	24	12,500	45
China	8	21	820	940,000	5	22,500	12
Congo	55	48	-	59,000	36	1,500	32
Congo, Dem. Rep.	58	54	4,750	-	-	96,000	58
Dominican Rep.	25	31	<100	23,000	11	350	18
Egypt	31	28	230	225,000	12	1,300	7
El Salvador	28	34	<100	17,000	11	250	17
Eritrea	75	53	270	16,000	10	1,750	30
Ethiopia	85	58	4,390	685,000	23	51,000	30
Gabon	43	32	<100	11,500	27	450	41
Gambia	75	53	-	10,000	20	1,000	64
Georgia	33	31	<100	11,000	21	<100	11
Ghana	65	40	230	120,000	18	12,000	60
Guatemala	34	20	<100	67,000	16	1,500	21
Guinea	73	43	360	83,000	23	8,000	40
Guinea-Bissau	83	53	100	12,500	17	1,750	31
Haiti	66	54	310	29,000	12	3,200	32
Honduras	34	31	<100	24,500	12	300	15
India	75	51	22,000	6,600,000	26	330,000	57
Indonesia	48	26	2,350	445,000	10	14,000	26
Iran	32	29	<100	125,000	9	3,000	23
Kazakhstan	49	36	<100	54,000	21	1,000	19
Kenya	60	43	930	105,000	10	23,500	70
Kyrgyzstan	42	31	<100	23,500	21	300	18
Lao PDR	54	48	200	27,000	14	2,000	42
Lebanon	21	24	<100	7,500	11	100	20
Lesotho	51	43	-	11,000	19	1,100	54
Liberia	69	44	170	29,000	18	5,000	38
Madagascar	73	42	520	43,000	6	13,000	42

VM DEFICIENCY: NATIONAL PROTECTION AUDITS

FOLATE DEFICIENCY	ECONOMIC IMPACT	FLOUR FORTIFICATION			SALT IODISATION	VITAMIN A SUPPLEMENTS	
Estimated annual no. of neural tube birth defects	Estimated % of GDP lost to all forms of VM deficiency	Type of programme M = Mandatory, V = Voluntary, P = proposed	IRON (parts per million)	FOLIC ACID (parts per million)	Estimated % of household salt iodised	Estimated % of children receiving at least one dose of vitamin A per year	
2,250	2.3	-	-	-	15	84	Afghanistan
1,400	2.1	-	-	-	35	75	Angola
<100	0.3	-	-	-	83	-	Armenia
225	0.7	V	55	2	26	-	Azerbaijan
8,400	0.9	P	66	1.5	70	90	Bangladesh
550	1.1	-	-	-	72	95	Benin
150	1.6	-	-	-	95	-	Bhutan
380	0.5	M	60	2	85	44	Bolivia
100	0.6	-	-	-	67	85	Botswana
5,250	-	P, M	42	2	87	-	Brazil
1,230	2.0	-	-	-	22	97	Burkina Faso
600	2.5	-	-	-	96	95	Burundi
950	1.4	-	-	-	14	57	Cambodia
1,100	0.8	-	-	-	84	99	Cameroon
300	-	-	-	-	86	90	Central African Rep.
800	1.2	-	-	-	58	91	Chad
38,000	0.2	-	-	-	93	-	China
300	1.9	-	-	-	-	100	Congo
5,250	0.8	-	-	-	93	80	Congo, Dem. Rep.
400	0.4	V	60	2	18	35	Dominican Rep.
3,800	0.5	-	-	-	80	-	Egypt
250	0.5	M	55	2	91	-	El Salvador
300	1.1	-	-	-	97	67	Eritrea
6,000	1.7	-	-	-	28	16	Ethiopia
<100	1.1	-	-	-	15	89	Gabon
100	1.3	-	-	-	8	91	Gambia
100	0.5	-	-	-	8	-	Georgia
1,300	1.1	-	-	-	50	100	Ghana
600	0.8	M	55	1.5	49	60	Guatemala
700	1.4	-	-	-	60	93	Guinea
150	1.5	-	-	-	1	100	Guinea-Bissau
400	0.8	V	44	2	12	30	Haiti
300	0.7	M	55	1.5	80	62	Honduras
50,000	1.0	-	-	-	50	24	India
6,800	0.5	M	50	2	65	61	Indonesia
2,100	0.3	P	30	2	94	-	Iran
400	0.6	V	55	1.5	76	-	Kazakhstan
2,000	0.8	-	-	-	91	90	Kenya
170	0.9	V	55	1.5	27	-	Kyrgyzstan
400	1.1	-	-	-	75	70	Lao PDR
140	0.4	-	-	-	87	-	Lebanon
100	0.8	-	-	-	69	-	Lesotho
330	1.2	-	-	-	-	100	Liberia
1,400	0.8	-	-	-	52	83	Madagascar

VM DEFICIENCY: NATIONAL DAMAGE ASSESSMENTS

	IRON DEFICIENCY			IODINE DEFICIENCY		VITAMIN A DEFICIENCY	
	Estimated prevalence of iron deficiency anaemia in children under 5 years (%)	Estimated prevalence of iron deficiency anaemia in women age 15-49 (%)	Estimated annual no. of maternal deaths from severe anaemia	Estimated annual no. of children born mentally impaired	Total Goitre Rate (%)	Estimated annual no. of child deaths precipitated	Estimated % of children under 6 with sub-clinical vitamin A deficiency
Malawi	80	27	380	115,000	22	17,500	59
Mali	77	47	590	270,000	42	24,000	47
Mauritania	74	42	140	24,000	21	1,500	17
Mongolia	37	18	<100	8,500	15	300	29
Morocco	45	34	210	-	-	1,750	29
Mozambique	80	54	1,470	134,000	17	14,000	26
Myanmar	48	45	460	205,000	17	13,000	35
Namibia	42	35	<100	12,000	18	500	59
Nepal	65	62	760	200,000	24	6,900	33
Nicaragua	47	40	<100	6,500	4	150	9
Niger	57	47	890	130,000	20	26,000	41
Nigeria	69	47	11,000	370,000	8	82,000	25
Pakistan	56	59	-	2,100,000	38	56,000	35
Papua New Guinea	40	43	<100	-	-	1,700	37
Paraguay	52	25	<100	22,000	13	150	13
Peru	50	32	120	60,000	10	1,100	17
Philippines	29	35	500	300,000	15	4,500	23
Rwanda	69	43	690	46,000	13	9,500	39
Senegal	71	43	310	86,000	23	9,500	61
Sierra Leone	86	68	780	40,000	16	13,250	47
South Africa	37	26	-	160,000	16	6,000	33
Swaziland	47	32	<100	4,000	12	600	38
Syria	40	30	<100	40,000	8	300	8
Tajikistan	45	42	<100	43,000	28	600	18
Tanzania	65	45	-	-	16	-	37
Thailand	22	27	<100	140,000	13	1,400	22
Togo	72	45	150	25,000	14	3,250	35
Turkey	23	33	100	335,000	23	2,600	18
Turkmenistan	36	46	<100	11,000	11	550	18
Uganda	64	30	890	111,000	9	29,000	66
Uzbekistan	33	63	<100	136,000	24	3,700	40
Venezuela	41	38	<100	60,000	10	150	5
Viet Nam	39	33	160	180,000	11	2,000	12
Yemen	59	49	480	143,000	16	10,000	40
Zambia	63	46	480	115,000	25	19,000	66
Zimbabwe	53	44	440	35,000	9	4,900	28
Totals			67,500	17,600,000		1,150,000*	

Note: Data on vitamin and mineral deficiency are imperfect. The figures given in this table are drawn from the best information currently available. Prevalence data are based on a global review of existing surveys of vitamin and mineral deficiencies. Functional consequences of VM deficiency are calculated using a specially-designed 'Profiles module'.

VM DEFICIENCY: NATIONAL PROTECTION AUDITS

FOLATE DEFICIENCY	ECONOMIC IMPACT	FLOUR FORTIFICATION			SALT IODISATION	VITAMIN A SUPPLEMENTS	
Estimated annual no. of neural tube birth defects	Estimated % of GDP lost to all forms of VM deficiency	Type of programme M = Mandatory, V = Voluntary, P = proposed	IRON (parts per million)	FOLIC ACID (parts per million)	Estimated % of household salt iodised	Estimated % of children receiving at least one dose of vitamin A per year	
1,100	1.4	-	-	-	36	75	Malawi
1,300	2.7	-	-	-	74	80	Mali
250	1.3	-	-	-	2	98	Mauritania
<100	0.6	V	55	2	45	93	Mongolia
1,000	0.2	P	45	1.5	41	-	Morocco
1,500	1.2	-	-	-	62	71	Mozambique
2,300	0.7	-	-	-	48	97	Myanmar
100	0.8	-	-	-	64	84	Namibia
1,600	1.5	-	-	-	63	98	Nepal
350	0.6	M	60	2	96	-	Nicaragua
1,300	1.7	M	40.7	-	15	89	Niger
9,500	0.7	-	-	-	98	77	Nigeria
11,000	1.7	-	-	-	17	100	Pakistan
350	0.5	-	-	-	-	-	Papua New Guinea
250	0.7	M	45	3	83	-	Paraguay
1,250	0.5	M	28	-	93	6	Peru
4,000	0.7	-	-	-	24	84	Philippines
700	1.1	-	-	-	90	94	Rwanda
750	1.3	-	-	-	16	85	Senegal
500	1.4	-	-	-	23	91	Sierra Leone
1,500	0.4	M	35	1.43	62	-	South Africa
<100	0.6	-	-	-	59	-	Swaziland
1,000	0.5	-	-	-	80	-	Syria
300	1.2	V	55	2	20	-	Tajikistan
-	-	-	-	-	67	93	Tanzania
2,200	0.4	-	-	-	74	-	Thailand
350	1.0	-	-	-	67	77	Togo
3,000	0.7	-	-	-	64	-	Turkey
200	0.7	-	-	-	75	-	Turkmenistan
2,600	1.0	-	-	-	95	37	Uganda
800	1.2	V	55	1.5	19	-	Uzbekistan
1,200	0.5	-	-	-	90	-	Venezuela
3,300	0.6	-	-	-	77	59	Viet Nam
1,800	1.3	-	-	-	39	100	Yemen
900	1.3	V	28.9	-	68	83	Zambia
800	0.7	-	-	-	93	-	Zimbabwe
210,000							

* This total may not yet reflect recent increases in the proportion of children receiving vitamin A supplements. Many nations have boosted vitamin A coverage by distributing capsules on National Polio Immunisation Days. Vitamin A supplementation is now estimated to be saving approximately 300,000 young lives each year, though there is a question mark over whether present levels of coverage can be maintained once polio is eradicated and National Immunisation Days are discontinued

The Micronutrient Initiative (MI) is a not-for-profit organisation specialising in addressing vitamin and mineral deficiency. MI is governed by an international Board of Directors. MI supports and promotes food fortification and supplementation programs in Asia, Africa and Latin America and provides technical and operational support in those countries where vitamin and mineral deficiency is most prevalent. MI carries out its work in partnership with other international agencies, governments and industry. MI is based in Ottawa, Canada and maintains regional offices in New Delhi, India, and Johannesburg, South Africa.

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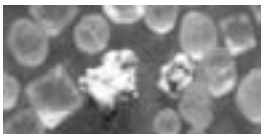
Breakthrough under the microscope:

Researchers at the University of Toronto have succeeded in 'double-fortifying' salt with both iron and iodine, opening the way for a daily dose of iron to be added to the diets of billions of people (see page 8). The photograph shows salt crystals (cube shapes) with added iodine (round shapes) and iron (irregular shapes). The iron and iodine compounds are micro-encapsulated in a dextrin coating to prevent them from interacting with each other and with impurities and moisture in salt.

VITAMIN & MINERAL DEFICIENCY
A WAKE UP CALL

Vitamin and mineral deficiencies affect a third of the world's people – debilitating minds, bodies, energies, and the economic prospects of nations.



Potassium iodate in salt

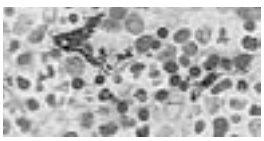
IODINE DEFICIENCY – THE MAJOR CAUSE OF INTELLECTUAL DEFICIENCY ON THE PLANET

Until recently iodine deficiency was known as goitre and thought to affect only a minority. Today we know the truth. More than 60 developing countries have iodine deficiency rates that are associated with a 10% to 15% lowering of average intellectual capacity.

Retinol (vitamin A)

VITAMIN A DEFICIENCY – RESPONSIBLE FOR A MILLION CHILD DEATHS A YEAR

Until recently, lack of vitamin A was seen as a nutritional problem causing blindness in severe cases. Now it is recognised as one of the most common and devastating of all health problems – compromising immune systems, opening the doors to disease, and leading approximately a million children a year to their deaths.



Iron in blood

IRON DEFICIENCY – THE MOST WIDESPREAD HEALTH PROBLEM IN THE MODERN WORLD

Until the 1990s, iron deficiency was seen as little more than a debilitating nuisance. Now, lack of iron is known to impair the normal mental development of 40% to 60% of the developing world's infants. Iron deficiency also debilitates the health and energies of an estimated 500 million women, and leads to more than 60,000 childbirth deaths a year.

LOW-COST SOLUTIONS

The VM deficiency problem has largely been brought under control in the industrialised nations. It could now be controlled world-wide by essentially the same low-cost strategies – adding vitamins and minerals to staple foods, getting tablets and capsules or syrups to vulnerable groups, and educating the public about small changes to daily diets.

For once the world is confronted by a major problem which could be brought under control in a relatively short time and at a relatively low cost.

WHICH COUNTRIES ARE PREPARED TO DEPLOY BIOLOGICAL WEAPONS OF MASS PROTECTION?