

Investing in the future

# A united call to action on vitamin and mineral deficiencies

GLOBAL REPORT 2009



**Flour Fortification Initiative**  
A Public-Private Partnership for Improved Nutrition



**Micronutrient  
Initiative**




**USAID**  
FROM THE AMERICAN PEOPLE



**THE WORLD BANK**





The global community should be outraged by the millions of children that either die or are disabled each year because of malnutrition. We know how to prevent and treat it. The missing link is the political will to place nutrition squarely on the development agenda and to commit the necessary resources to implement programs, particularly food fortification, that we know can deliver sustainable improvements not only to the current generation of people at risk but to the lives of generations to come.

**Marc Van Ameringen, Executive Director, GAIN**

We encourage all of our industry peers to find their niche in these proven, cost-effective strategies to reduce vitamin and mineral deficiencies around the world.

**Scott Montgomery, Vice President and Global Procurement Leader, Cargill Inc.,  
FFI Executive Management Team Chairman**

The global community has committed, through the Millennium Development Goals, to meet the rights and needs of all the world's citizens. We are working to reduce poverty and child mortality, improve maternal health, provide universal primary education and ensure gender equality. Empowering people in all countries to consume adequate amounts of essential micronutrients plays an important role in meeting these objectives.

**Venkatesh Mannar, President, Micronutrient Initiative**

Good nutrition, especially in the first years of a child's life, provides lifelong benefits in health, education and productivity. However, one in four children under-five in the developing world – approximately 148 million children – suffer from undernutrition. Affordable and proven micronutrient interventions to address undernutrition exist. We must work collectively to scale up access to these micronutrients, so children everywhere have the chance to reach their full potential and contribute to the development of their communities.

**Ann M. Veneman, Executive Director, UNICEF**

At least two children die every minute of every day because they have not received the protection vitamin A supplementation can provide. In the span of two decades, micronutrient supplementation programs have become a mainstream national health goal to reduce childhood mortality and morbidity in 70 countries. The goal now must be to ensure that every vulnerable child receives the vitamin A they require.

**Alfred Sommer, Dean Emeritus and Professor, Johns Hopkins University**

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# Executive Summary



*A young girl in Ethiopia being administered vitamin A. Approximately one third of the developing world's children under the age of five are vitamin A-deficient, and therefore ill-equipped for survival. © MI*

**VITAMINS AND MINERALS ARE VITAL COMPONENTS** of good nutrition and human health, advancing physical and intellectual development in many important ways. A number of vitamins and minerals – also known as micronutrients – are particularly important because of the large numbers of people around the world who are deficient in them. These are vitamin A, iodine, iron, zinc and folate.

Around the world, billions of people live with vitamin and mineral deficiencies. For instance, approximately one third of the developing world's children under the age of five are vitamin A-deficient, and therefore ill-equipped for survival. Iron deficiency anaemia during pregnancy is associated with 115,000 deaths each year, accounting for one fifth of total maternal deaths.

Children, whose mothers died giving birth, may be neglected. Children who themselves have insufficient micronutrient intake and absorption can suffer serious lifelong repercussions. If they survive infancy, their bodies may be weak and prone to disease. They may have birth defects or become blind. They may not go far in school.

When whole populations suffer from malnutrition, including

a lack of critical vitamins and minerals, nations likewise cannot fulfill their potential. Health-care costs rise, education efforts are thwarted, the workforce is less capable and productive, and economic activity is curtailed. Human capital overall is significantly diminished.

Yet there is encouraging news from many corners. Working together, national governments, donors, science and industry have made huge strides in delivering cost-effective solutions to vulnerable populations. These successes, if further scaled-up, present exciting opportunities to improve the lives of those who have thus far not been reached.

## The Causes of Vitamin and Mineral Deficiencies

The causes of vitamin and mineral deficiencies are multiple and interconnected. At the most basic level, the problem is related to diet. Throughout the world, poor people do not consume sufficient amounts of nutrient-rich foods such as meat, eggs, fish, milk, legumes, fruits and vegetables. The problem is made worse by inadequate health care and sanitation, disease, and a lack of education in infant and childcare.



Quality, varied diets would resolve most vitamin and mineral deficiencies. However, improving the diets of the world's poor is a complex and long-term undertaking that is largely dependent on rising incomes, improved access to food, better health and nutrition services delivery, and changing infant and young-child feeding practices. Well-integrated strategies to address nutrition at the national level will be critical for long-term success in reducing malnutrition, improving health, educational achievement, and economic productivity. In the short term, however, many lives can be saved and improved through a range of cost-effective interventions, including supplementation and fortification.

## Call to Action: Solving Vitamin and Mineral Deficiencies through Partnerships

The successful delivery of large-scale interventions requires broad-based partnerships. National governments take the lead by identifying needs, setting and monitoring national policy and standards, budgeting for micronutrient programmes, training health-care providers, and launching social marketing and education campaigns. Their long-term commitment is vital.

Non-governmental organizations can support this commitment with expertise in programme design and delivery, continuing research, advocacy, and the procurement of products. International donors – governments and philanthropic groups alike – help across the board, by assisting with large-scale procurement, boosting global supplies, and covering implementation costs.

Internationally and locally, the private sector brings its pharmaceutical and food processing expertise and ingenuity to produce, promote, and ensure quality control. Small-scale processors and farmers also play key roles. Partnerships have created some stunning successes in the past decade.

**Vitamin A** – Research has shown that, where a population is at risk of vitamin A deficiency, vitamin A supplementation reduces mortality in children between six months and five years of age by an average of 23%. Global efforts to provide young children with twice-yearly supplements have involved 103 countries. In 1999, just 16% of children in these countries received full supplementation. By 2007, that number had more than quadrupled to 72%.

**Salt iodization** – When the power of iodine is unleashed through intake of iodized salt, the results are impressive. In communities where iodine intake is sufficient, average IQ is

shown to be on average 13 points higher than in iodine-deficient communities. Between 1993 and 2007, the number of countries in which iodine-deficiency disorders were a public health concern was reduced by more than half, from 110 to 47.

Like these successes, other approaches have shown great promise. One approach is food fortification, which is the process of adding vitamins and/or minerals to foods to increase their overall nutritional content. Multiple micronutrient solutions, whether in packets for in-home use or delivered through clinics and public campaigns, warrant urgent and wide expansion.

## The Best Investment in the World

As the global financial crisis unfolds and available funds from all sources are shrinking, the need for development assistance is expanding at an alarming pace. It is more important than ever that priority for investments goes to measures that yield the highest rates of return.

Micronutrients are inexpensive commodities. Low-cost supplements and fortificants are already available. For instance, it is estimated that the cost of salt iodization is a mere five cents per person per year. Vitamin A capsules cost two cents each. Micronutrient initiatives can easily be integrated into ongoing health services, or into existing methods for food production.

With the low cost of interventions and their high returns in improved capacity, the benefit:cost ratio of micronutrient programming is unmatched by any other large-scale health or economic intervention.

This simple truth has been endorsed by a panel of eight of the world's most distinguished economists. In May 2008, the Copenhagen Consensus panel considered 30 options and ranked the provision of micronutrients as the **world's best investment for development**.

They determined that vitamin A and zinc supplementation for children provided the very best returns: an annual investment of US\$ 60 million would yield benefits worth more than US\$ 1 billion per year. Micronutrient fortification ranked third; biofortification ranked a close fifth.

Achieving the Millennium Development Goals by 2015 will require strategic vision on the part of all those with resources to invest. Much is already understood about early nutrition needs and what works. Commitment and funds, supported by strong partnerships, will extend the reach of micronutrient interventions and leave no one behind.

# Summary of Recommendations

Delivering vitamins and minerals to large populations involves commitment, coordination, planning and cooperation – all held together by strong and durable partnerships. Key partners in micronutrient interventions include national governments, non-governmental organizations, donors, aid agencies, foundations, industry, community leaders, and the agricultural sector.

The following provides a number of priority actions for each intervention that should be undertaken by national governments, industry and international organizations.

## Vitamin A

- ✓ Scale up the delivery of integrated package of health services, including twice yearly vitamin A supplementation for children aged between 6 months and five years, to achieve at least 80% coverage on a recurrent basis.
- ✓ Target the hard-to-reach through complementary strategies, such as special outreach programmes, to reach the final 20% who have not been reached through regular programmes.
- ✓ Improve programme sustainability by mobilizing resources in national budgets to cover costs pertaining to vitamin A supply and local distribution.
- ✓ Establish integrated delivery strategies, monitoring of programmes, and tracking of progress.

## Salt Iodization

- ✓ Enact mandatory legislation and ensure adequate resources are made available to enforce it.
- ✓ Build financial sustainability to transition from a donor-supported to a market-supported supply of iodate.
- ✓ Undertake strategic advocacy and communication efforts through media, health systems, and schools.
- ✓ Strengthen population-monitoring systems so that programme adjustments can be made as habits and diets change over time.
- ✓ Create incentives for processors to iodize their salt.

## Food Fortification

- ✓ Set and monitor national standards for food fortification programmes and ensure standards are enforceable, so that all producers have equal financial obligations.
- ✓ Identify and train fortification champions from both public and private sectors to build on success to date and help rapidly expand fortification efforts.
- ✓ Launch communication and public education initiatives to create a market demand for products and support for government investment.

# Summary of Recommendations *Continued*

## **Multiple Micronutrient Supplements for Children**

- ✓ Scale up availability of multiple micronutrient supplements for in-home use, such as Sprinkles, in non-malaria endemic regions.
- ✓ Direct research efforts to find safe and cost-effective ways to improve iron intake by young children in malarial areas.

## **Supplements for Women of Child-bearing Age**

- ✓ Expand and scale up iron and folic acid supplementation for all women of child bearing age, with special focus on pregnant women.
- ✓ Bring increased focus on improving adherence rates, through community outreach, counselling, and related efforts.
- ✓ Explore the feasibility of providing women with multiple vitamin and mineral supplements.

## **Zinc Supplementation for Diarrhoea Management**

- ✓ Incorporate zinc supplementation into national diarrhoea management policy.
- ✓ Ensure zinc supply.
- ✓ Identify public and private delivery strategies.
- ✓ Create demand through social marketing campaigns.
- ✓ Provide adequate financing for start-up.

## **Food-based Approaches**

- ✓ Research best practices for community-based programmes – including nutrition-education approaches and operational solutions that can be replicated and supported by local institutions.
- ✓ Integrate micronutrient interventions with existing health, nutrition, and food security programmes.
- ✓ Provide regionally based technical assistance to ensure quality programme delivery.



# 1 Introduction

**MICRONUTRIENTS – OR VITAMINS AND MINERALS NEEDED IN SMALL QUANTITIES** – are essential to a good start in life and robust growth and development. In particular, vitamin A, iodine, iron, zinc and folate play pivotal roles in maintaining healthy and productive populations.

With them, a young child has a chance to survive and thrive, learn and stay in school, and grow into a productive adult. Without them, a child's full potential can be lost forever. Likewise, when whole populations do not have access to basic vitamins and minerals, nations suffer enormous lost potential. Widespread deficiencies cripple health-care budgets, undermine education efforts, weaken a workforce, and debilitate an economy.

Around the world, at least two billion people live with vitamin and mineral deficiencies. The delivery of micronutrients to those who need them is a giant undertaking, but one that has already seen some significant successes benefitting large populations.

Many micronutrient programmes have yielded well-documented returns in improved physical and intellectual capacity. With increased long-term investment by national governments and their partners in development, they could yield much more. Emerging new programmes, which are affordable, feasible and well-grounded in science, are now also available to help expand still further the potential benefits offered by micronutrients.

The relatively low cost and high returns of micronutrient interventions are so good they have won the highest praise from the world's top economists. In 2008, the Copenhagen Consensus panel determined that vitamin A and zinc supplementation for children provided the very best return on investment across all global development efforts. Fortifying foods with iron and iodine was ranked third and biofortification ranked fifth out of a total of 30 possible programme choices, showing that across the board, micronutrient interventions are some of the most cost-effective development efforts.

## Chapter 1 introduces the report's key themes:

- ✓ the importance of vitamins and minerals (micronutrients), and the costs of deficiencies to individuals and societies
- ✓ the proven and impressive cost:benefit ratio of micronutrient programmes
- ✓ how micronutrient interventions move us toward Millennium Development Goals
- ✓ the implications of volatile commodity markets and global financial instability for the world's poor



*A mother and daughter in rural Bolivia. Vitamins and minerals play important roles in human development and physical well-being. © MI*

**Table 1. How micronutrient interventions support Millennium Development Goals**

MILLENNIUM DEVELOPMENT GOAL	MICRONUTRIENT ROLE
<b>GOAL 1 – ERADICATE EXTREME POVERTY AND HUNGER</b>	<ul style="list-style-type: none"> <li>• iron intake can reduce anaemia – leading to greater productivity and earning potential</li> <li>• salt iodization reduces iodine deficiency disorders – increasing learning ability and intellectual potential, and leading ultimately to better-educated citizens earning higher wages</li> <li>• zinc reduces stunting among children</li> </ul>
<b>GOAL 2 – ACHIEVE UNIVERSAL PRIMARY EDUCATION</b>	<ul style="list-style-type: none"> <li>• salt iodization reduces iodine deficiency – improving cognitive development and learning potential</li> <li>• iron in young children improves cognitive development to help them succeed academically later in life</li> <li>• zinc reduces the frequency and severity of diarrhoea – decreasing the number of school days lost</li> <li>• vitamin A prevents childhood blindness</li> <li>• folic acid prevents disability due to neural tube defects</li> </ul>
<b>GOAL 3 – PROMOTE GENDER EQUALITY AND EMPOWER WOMEN</b>	<ul style="list-style-type: none"> <li>• iron improves women’s economic productivity</li> <li>• addressing under-nutrition empowers women more than men: improved micronutrient intake by women can help to correct inequalities in their access to adequate and nutritious food</li> </ul>
<b>GOAL 4 – REDUCE CHILD MORTALITY</b>	<ul style="list-style-type: none"> <li>• vitamin A significantly improves child survival rates</li> <li>• zinc reduces the frequency and severity of diarrhoea, a major cause of child mortality</li> <li>• salt iodization reduces iodine deficiency – lowering rates of miscarriage, stillbirth and neonatal death</li> </ul>
<b>GOAL 5 – IMPROVE MATERNAL HEALTH</b>	<ul style="list-style-type: none"> <li>• iron improves maternal survival rates</li> <li>• salt iodization prevents iodine deficiency disorders and its consequences such as spontaneous abortion, stillbirth, and impaired mental function</li> </ul>

## Millennium Development Goals

The belief that every human being has the right to benefit from scientific, technical, and social progress underpins the Charter of the United Nations of 1945. It was later enshrined as rights in the Declaration of Human Rights and the Convention on the Rights of the Child. At the outset of the millennium, the world’s leaders set specific goals and a timeline of 2015 to bridge the gap between rights and reality for the world’s poor.

Achieving the Millennium Development Goals (MDGs) by

*Prioritization of investments with high rates of return has become more important than ever.*

2015, especially as the world adjusts to financial challenges, will require strategic vision on the part of those with resources to invest. Micronutrient interventions offer the world excellent and proven opportunities to meet these goals. As seen in Table 1, the provision of key vitamin and mineral interventions supports the realization of the MDGs in a variety of ways.

## The Escalating Number of Poor People

Recent trends in commodity markets and the worldwide financial situation are accelerating the numbers of people at risk of vitamin and mineral deficiencies. In 2007, the Food and Agriculture Organization index of food prices rose by 24%, and rose again by 51% between October 2007 and October 2008.<sup>1</sup> In November of 2008, the World Bank estimated that high food and fuel prices had increased the number of extremely poor by at least 100 million people, and had set back seven years of progress in meeting the MDG target for the reduction of poverty.<sup>2</sup>

The World Bank also estimated that in 2008 alone, increased

food prices may have been responsible for an additional 44 million children experiencing permanent physical and cognitive setbacks due to malnutrition.<sup>3</sup>

The global financial crisis spells more bad news. National government revenues are down, jeopardizing budgets for health and education. Donor government revenues are also lower, jeopardizing overseas development expenditures.

Taken together, the financial crisis and underlying factors of increasing demand and expected future volatility in commodity markets have made the prospects for the world's poor especially grim. Prioritization of investments with high rates of return has become more important than ever.

## Micronutrient intake decreased during Indonesia's financial crisis, leading to higher rates of anaemia



*During Indonesia's financial crisis in the 1990s, families decreased their consumption of foods rich in vitamins and minerals. © MI*

increased from 52% to 68% during the period. The effects were particularly severe for children conceived during and immediately prior to the crisis.

With compelling evidence that adult labour productivity lost as a result of childhood iron-deficiency anaemia can lead to significant losses in gross domestic product (GDP), the long-term effects of such consequences of financial crises are staggering.<sup>5</sup>

Poor women and children are especially susceptible to vitamin and mineral deficiencies. During economic crises, their vulnerability is much greater. Higher food prices and lower incomes usually force them to reduce their intake of foods that are high in micronutrient content.

A study of how the Indonesia financial crisis of the late 1990s affected micronutrient consumption confirmed this. The authors found that, among the poor, household consumption of eggs and dark leafy vegetables (both important sources of micronutrients) fell significantly.<sup>4</sup> This reduction in consumption of quality foods between December 1996 and July 1998 (approximately the peak crisis period) resulted in increased prevalence of anaemia for both mothers and children. In fact, the study found that anaemia rates among children

# 2 How Micronutrients Affect Human Health

## Chapter 2 briefly describes the benefits of:

- ✓ vitamin A
- ✓ iodine
- ✓ iron
- ✓ zinc
- ✓ folate

**SINCE THE EARLY 20<sup>TH</sup> CENTURY**, scientific and technical discoveries have led to improved health and prosperity for those who have been able to benefit from them. One is the discovery that food contains important vitamins and minerals, and that a deficiency in some of these can cause a range of health and developmental problems.

As research progresses and micronutrient interventions expand, evidence continues to emerge of their impressive impact on survival and development. Remarkably powerful for the tiny levels required, micronutrients support an array of critical biological functions including development of the brain and the nervous system, skeletal development and growth, immune function, and eye function.<sup>6</sup>

Five micronutrients stand apart, both because of their importance and the numbers of people who are deficient in them. These micronutrients have become the focus of highly successful programmes that have reached millions of children and adults. Table 2 shows just how much difference they make.

## VITAMIN A: Vital for survival and sight

Thanks to its powerful ability to boost the immune system, vitamin A is a critical micronutrient for the survival and physical health of children exposed to disease.

This significant contribution to child health was first explored in the mid 1980s in Indonesia. A study showed remarkable reductions in deaths of children under five years of age when supplemented with vitamin A.<sup>7</sup> Subsequent research showed that, where a population is at risk of vitamin A deficiency, supplementation reduces mortality in children between six months and five years of age by an average of 23%.<sup>8</sup>

In preventing blindness in childhood, few factors are as important as levels of vitamin A. Also known as retinol, it is indispensable to the retina's ability to adapt to dark lighting conditions. People without this ability suffer from night blindness, which is the inability to see shapes in low light.

Vitamin A also promotes healthy eye surface membranes, helping prevent scarring of the cornea. This makes adequate vitamin A vital for the prevention of a widespread condition called xerophthalmia, a serious eye disorder that is the primary cause of sight loss among the five million visually disabled children in the world.<sup>9</sup> Studies have shown reductions of up to 70% in the prevalence of xerophthalmia in children after sustained vitamin A supplementation.<sup>10</sup>



*Young children in Gonaives, Haiti. Iodine is one of the most important elements required by a developing fetus because of its effect on brain development.*

© MI



**Table 2. Micronutrients: at the core of survival, development and health**

MICRONUTRIENT	IMPACT THROUGH PROGRAMMES
VITAMIN A	<ul style="list-style-type: none"> <li>• 23% reduction in under-five mortality rates</li> <li>• 70% reduction in childhood blindness</li> </ul>
IODINE	<ul style="list-style-type: none"> <li>• 13-point increase in IQ</li> </ul>
IRON	<ul style="list-style-type: none"> <li>• 20% reduction in maternal mortality</li> </ul>
ZINC	<ul style="list-style-type: none"> <li>• 6% reduction in child mortality</li> <li>• 27% reduction of diarrhoea incidence in children</li> </ul>
FOLATE	<ul style="list-style-type: none"> <li>• 50% reduction in severe neural tube birth defects, such as spina bifida</li> </ul>

## IODINE: Fundamental for the intelligence of the next generation

Iodine is one of the most important elements required by a developing fetus because of its effect on brain development. While the link between iodine and goitre – the most visible effect of severe iodine deficiency – has been known since the early 20th century,<sup>11</sup> it was not until the 1970s and 1980s that the links between iodine and fetal cognitive development began to be understood.<sup>12</sup>

When the intake of iodine is increased through the consumption of iodized salt, the results are impressive. In communities where iodine intake is sufficient, average IQ is shown to be on average 13 points higher than in iodine-deficient communities.<sup>13</sup>

## IRON: Essential for maternal and fetal health, learning, and productivity

Iron is an essential mineral for human development and function. It helps produce haemoglobin, the oxygen-carrying component of red blood cells. As these cells carry oxygen to the muscles and brain, iron is critical for motor and cognitive development in childhood, and for physical activity in all humans. If iron levels are too low, the body makes too few red blood cells, and individuals develop anaemia.

Iron is also critical to the health of a pregnant mother and her unborn child. A woman needs more iron during

pregnancy because the fetus and placenta both need additional iron. Iron supplementation during pregnancy lowers the risk of maternal mortality due to haemorrhage, the cause of more than 130,000 maternal deaths each year.<sup>14</sup> Supplementation also helps to lower the risks of premature birth and low birth weight.

*Eliminating anaemia in adults can result in productivity increases of up to 17%. These increases are equivalent to 2% of GDP in the worst affected countries.*

Studies have shown that infants with anaemia caused by iron deficiency have lower mental scores and lower motor scores than infants without anaemia.<sup>15</sup> Ensuring sufficient iron levels in the first months and years of life is, therefore, critical.

## ZINC: Fights diarrhoea and infections and promotes growth

Zinc promotes immunity, resistance to infection, and the growth and development of the nervous system. It also promotes the production of antibodies against intestinal pathogens.<sup>16</sup>

Diarrhoeal disease causes 18% of deaths in children under five years of age.<sup>17</sup> Studies have shown that zinc supplementation, given with oral rehydration therapy, can



*Children play in a village in Nepal. Zinc supplements, when used in addition to oral rehydration, reduce the duration of persistent diarrhoea by approximately 27%. © MI*

reduce the incidence of diarrhoea in children by 27%.<sup>18</sup> It can also reduce the incidence of acute lower respiratory tract infections by 15%.<sup>19</sup> A 10–14-day course of zinc supplementation has also been shown to increase children's resistance to further episodes of diarrhoea and other disease for two to three months following supplementation.<sup>20</sup>

## **FOLATE: Essential for healthy fetal development**

In the earliest days of fetal development, folate is one of the most important micronutrients for the emerging human

being. Necessary for the production of new cells, folate promotes the healthy early development of the spine, spinal cord, skull and brain.

Debilitating and sometimes deadly neural tube defects – including spina bifida – occur three to four weeks after conception if part of the neural tube does not close as it is developing. Ensuring sufficient levels of folate in women prior to conception has been shown to reduce by 50% the number of cases of neural tube defects.<sup>21</sup>



# 3 The Costs of Vitamin and Mineral Deficiencies

**THE FIRST 1,000 DAYS** – from conception until the age of two – are the most critical for any child. After birth, if exclusive breastfeeding is not practised during the first six months of life or if the solid foods introduced after that period are nutrient-poor, young children are likely to suffer vitamin and mineral deficiencies.

*Up to two billion people suffer the consequences of vitamin and mineral deficiencies.*

Deficiencies lead to more frequent infections, reduce children's ability to fight and survive disease, and impair mental capacity. These risks remain serious as children grow and develop. They cannot learn as well, and lose school days due to illness.

In adulthood, vitamin and mineral deficiencies negatively affect physical energy and, therefore, productivity. Deficiencies during pregnancy threaten the health and lives of women and impact their unborn children.

**Chapter 3 explores the repercussions of vitamin and mineral deficiencies, from conception to adulthood, including:**

- ✓ child and maternal deaths
- ✓ physical disabilities
- ✓ lowered intellects
- ✓ lost productivity
- ✓ burden on caregivers and health-care systems

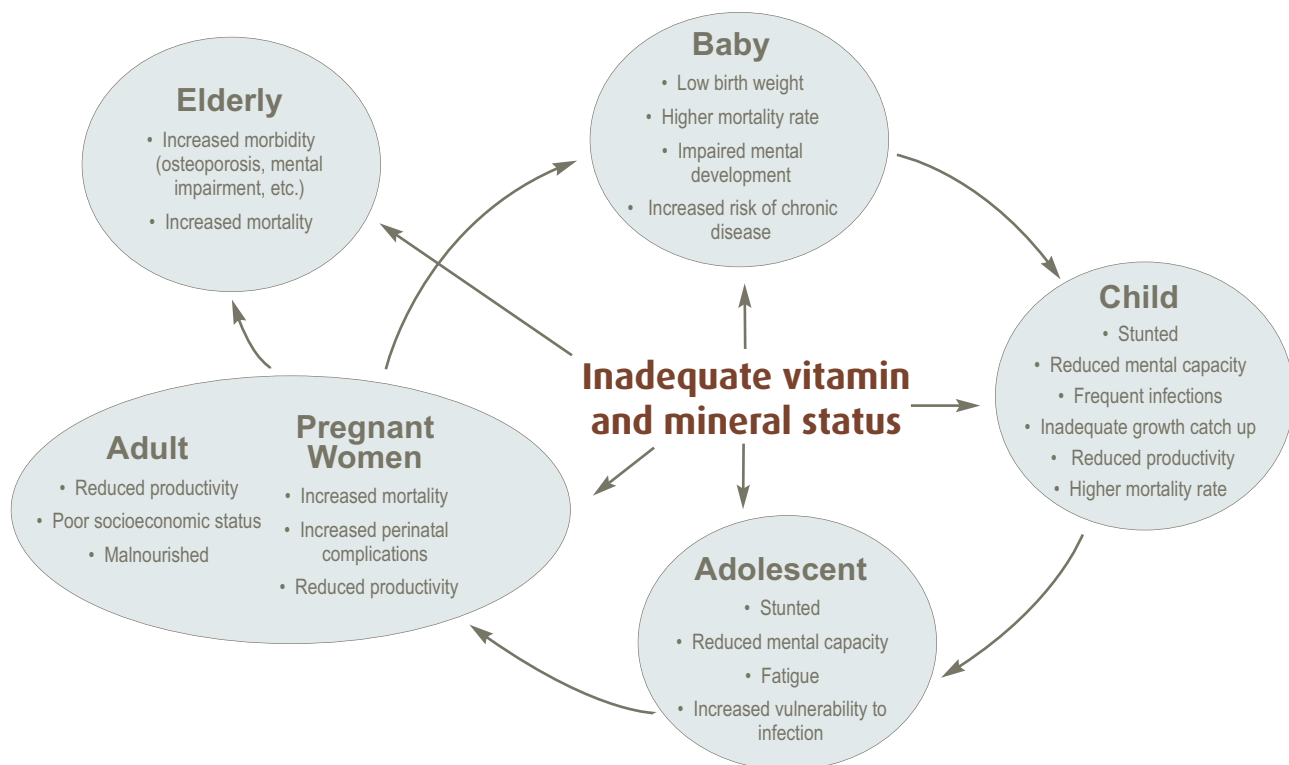
## Lives Lost

The most unacceptable effects of vitamin and mineral deficiencies are unnecessary child and maternal deaths. For too many, death comes with pregnancy and birth, and for even more it comes after battles with disease.

**Table 3. Human toll of vitamin and mineral deficiencies**

TYPE OF REPERCUSSION	NUMBERS AFFECTED
LIVES LOST ANNUALLY	<ul style="list-style-type: none"><li>• 1.1 million children under five die due to vitamin A and zinc deficiencies</li><li>• 136,000 women and children die because of iron-deficiency anaemia</li></ul>
LIVES IMPAIRED ANNUALLY	<ul style="list-style-type: none"><li>• 18 million babies are born mentally impaired because of maternal iodine deficiency</li><li>• 150,000 babies are born with severe birth effects due to inadequate maternal folate intake</li><li>• 350,000 children become blind due to vitamin A deficiency</li></ul>
LOST PRODUCTIVITY	<ul style="list-style-type: none"><li>• 1.6 billion people suffer reduced productive capacity due to anaemia</li></ul>

**Figure 1. Consequences of vitamin and mineral deficiencies during the life cycle**



Adapted from the United Nations Administrative Committee on Coordination Sub-Committee on Nutrition (ACC/SCN), Fourth Report on the World Nutrition Situation, 2000, Geneva: ACC/SCN in collaboration with IFPRI.

*1,000 days that can last a lifetime – if vitamin and mineral deficiencies are not corrected between conception and the age of two, it may be too late to correct them later.*

Deficiencies in vitamin A and zinc are particularly dangerous for children who are fighting measles, diarrhoea and malaria. A full 20–24%<sup>22</sup> of deaths from these three diseases are attributable to inadequate vitamin A or zinc. Vitamin A deficiency annually claims the lives of almost 670,000 children under five and zinc deficiency claims more than 450,000.<sup>23</sup> Approximately one third of the world's children under the age of five have inadequate dietary intake of vitamin A and are, therefore, ill-equipped for survival.<sup>24</sup>

Iron-deficiency anaemia during pregnancy is associated with 115,000 women's deaths each year,<sup>25</sup> which account for one fifth of total maternal deaths.<sup>26</sup> This has the additional result

of leaving tens of thousands of children without the protective care of their mothers and at further risk of illness and death. Iron-deficiency anaemia is also estimated to cause almost 600,000 stillbirths or deaths of babies within their first week of life.<sup>27</sup>

*One fifth of all maternal deaths are associated with iron-deficiency anaemia during pregnancy.*

## Lives Impaired

While the number of children and women who die because of vitamin and mineral deficiencies is great, greater still is the number of people who live with these deficiencies and their consequences. The negative impact on their health and well-being is significant. More often than not, they suffer multiple deficiencies and, therefore, multiple impairments.

## Lowered intellect

Reduced intellectual capacity undermines investments in



*A young man shares a poster about the effects on the thyroid gland of iodine deficiency disorders (IDD) with a group of adolescents. They are part of a peer-to-peer education programme at a UNICEF-supported summer camp for vulnerable children in the village of Vasyshchevo, Ukraine. © UNICEF/NYHQ2005-1809/Pirozzi*

education and perpetuates cycles of poverty. It is a significant barrier to progress for any nation that hopes to achieve economic growth and improved standards of living. Maternal iodine deficiency is recognized as the greatest cause of preventable mental impairment in the world. In developing countries, 38 million newborns each year are at risk of iodine deficiency.<sup>28</sup>

Intellectual ability is also affected by iron. The effects of iron-deficiency anaemia during infancy and the first years of life on cognitive performance are lasting. Globally, it is estimated that 47% of children under the age of five suffer from anaemia.<sup>29</sup> It is generally assumed that half of all anaemia cases are due to iron deficiency.<sup>30</sup>

## **Disability**

Disability can be a devastating burden for individuals and their families who lack resources. His or her options for learning and income earning are limited. In the case of severe disability, even significant resources may not be

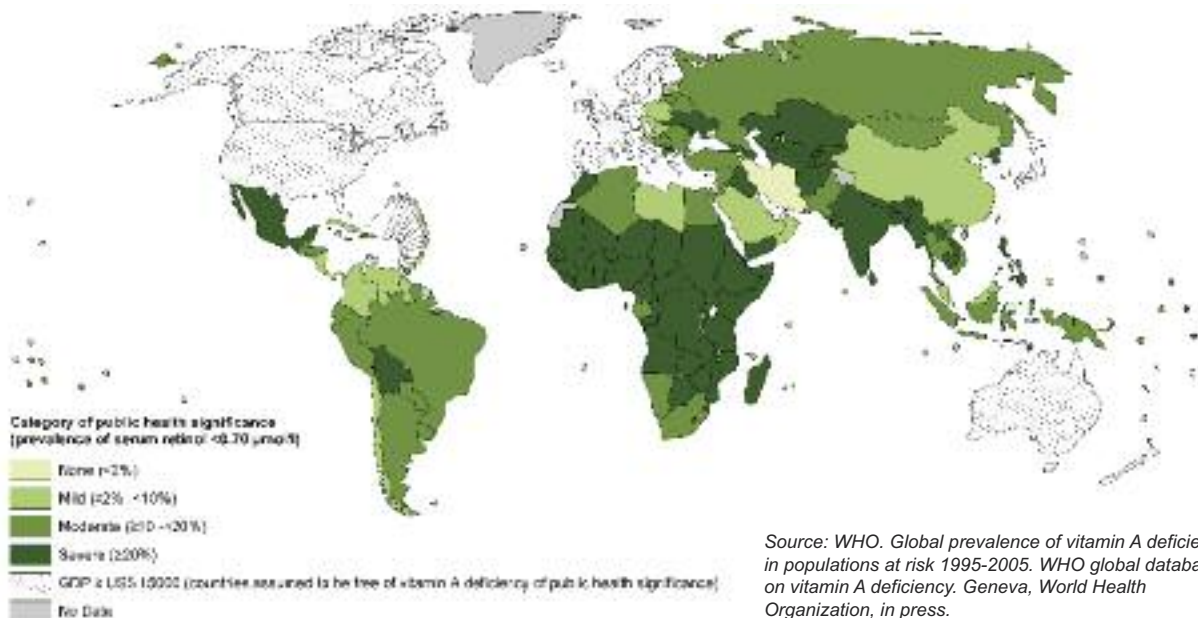
enough to enable economically productive lives. A disabled individual in a household with few resources usually experiences a greatly diminished quality of life.

Each year, spina bifida and anencephaly – the two most common types of neural tube defects – affect an estimated 300,000 newborns worldwide.<sup>31</sup> Severe cases of spina bifida require treatment by surgery, and even with this intervention, most affected children live with some paralysis of the legs and bowel control problems.<sup>32</sup> Most babies with anencephaly do not survive birth. At least half of these cases could be prevented if the mother consumes enough folic acid before and during the early stages of pregnancy.<sup>33</sup>

*Without benefit of folic acid fortification or supplementation programmes, 150,000 babies are born every year with severe defects that are otherwise preventable.*

## Global Impact of Vitamin and Mineral Deficiencies<sup>a</sup>

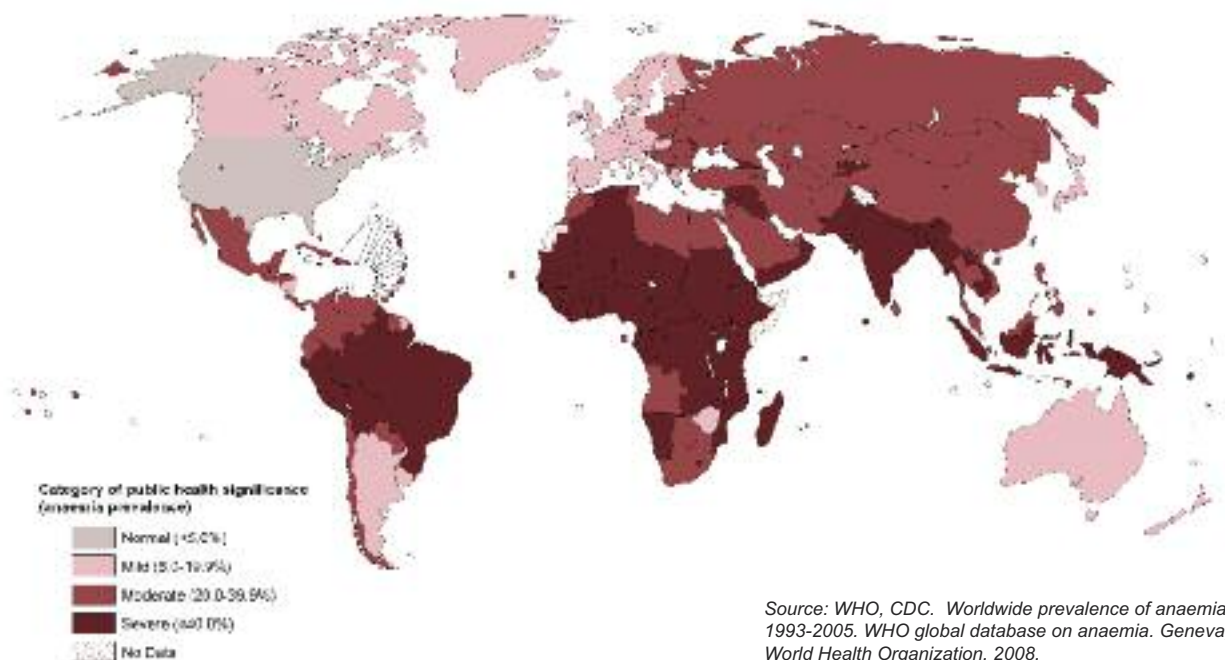
**Map 1. Prevalence of vitamin A deficiency among preschool-aged children by country**



Source: WHO. Global prevalence of vitamin A deficiency in populations at risk 1995-2005. WHO global database on vitamin A deficiency. Geneva, World Health Organization, in press.

As Map 1 indicates, vitamin A deficiency is a significant public health problem in more than half of all countries. Regions where vitamin A is deficient in the diet include South Asia, most of sub-Saharan Africa, some countries in Latin America, and parts of China.

**Map 2. Anaemia as a public health problem by country: Preschool-aged children**



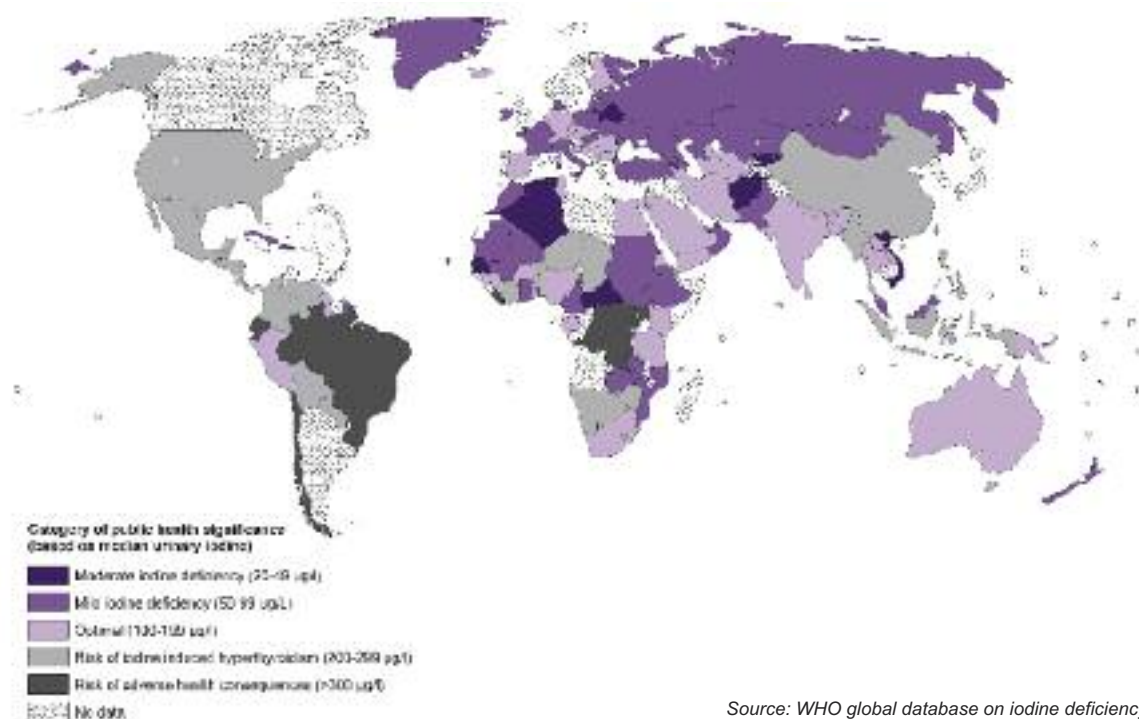
Source: WHO, CDC. Worldwide prevalence of anaemia 1993-2005. WHO global database on anaemia. Geneva, World Health Organization, 2008.

Map 2 indicates that, like vitamin A deficiency, anaemia prevalence is concentrated in sub-Saharan African, South Asia and parts of Latin America.

<sup>a</sup> The boundaries and names shown and the designations used on these maps do not imply the expression of any opinion whatsoever on the part of the World Health Organization, the United Nations or any other agency concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement.



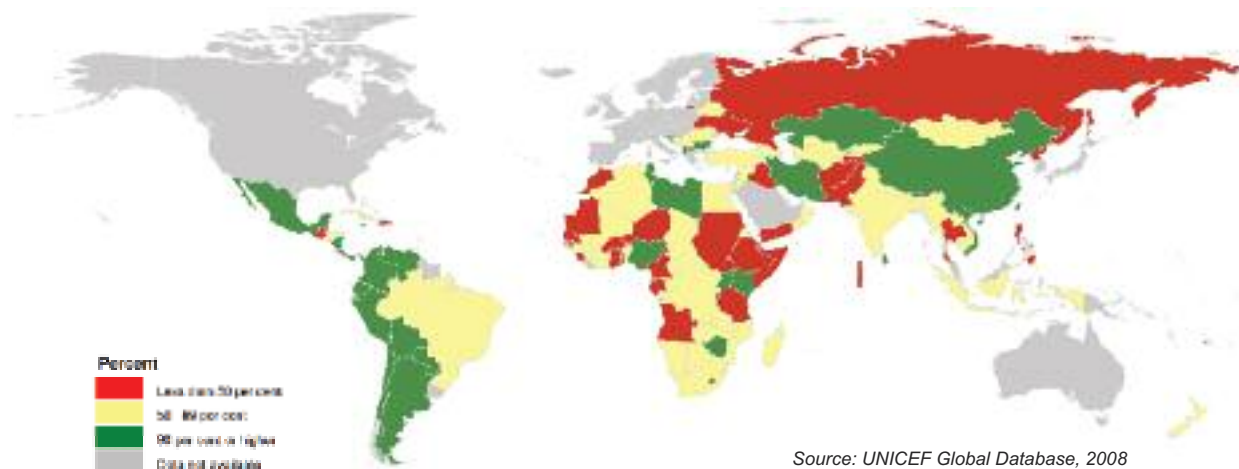
**Map 3. Iodine status of school-aged children by country, based on the median urinary iodine concentration<sup>b</sup>**



Source: WHO global database on iodine deficiency, 2007.

As Map 3 indicates, iodine deficiency remains a public health problem in approximately 45 countries. Unlike vitamin A deficiency, which is concentrated in the developing world, iodine deficiency is a problem in both developed and developing countries. In fact, Europe has the highest estimated prevalence of insufficient iodine intakes at 52%.<sup>39</sup>

**Map 4. Percentage of households consuming adequately iodized salt (2000–2007)**



Source: UNICEF Global Database, 2008

As Map 4 illustrates, 34 developing countries have achieved the universal salt iodization goal, and an additional 38 countries are considered 'on track' for elimination of iodine deficiency disorders. These are countries that have either shown increases in coverage of at least 20% over the previous decade or that have reached between 80% and 89% coverage with no indication of possible decline. Further information on progress-to-date and continuing challenges is included in Chapter 4.

<sup>b</sup> In generating Map 3, nationally representative data was used in the majority of cases. However, in 36 cases, sub-national data was used due to the lack of nationally representative data. For example, the estimate for India is based on data from 20 state and district surveys, representing 15 unique states.

It is estimated that 5 million children are affected by night blindness linked to vitamin A deficiency.<sup>34</sup> Every year, 350,000 children become blind because of this deficiency,<sup>35</sup> representing 70% of all new cases of childhood blindness annually.<sup>36</sup> These children face daunting physical, social and ultimately economic challenges.

## Loss of Productivity

Every day, national economies suffer significant yet unnecessary losses in productivity due to vitamin and mineral deficiencies. In countries with the highest numbers of people living with physical and intellectual impairments, the lost potential for economic growth is staggering. Mothers tending to sick or disabled children lose days of work. Adults living with reduced energy and intelligence are unable to fully contribute to society.

As the most common and widespread nutritional disorder in the world, iron-deficiency anaemia undermines global productivity by compromising both physical and intellectual capacity. In 2006, approximately 1.62 billion people had anaemia.<sup>37</sup>

In China, vitamin and mineral deficiencies represent an annual GDP loss of US\$ 2.5-5 billion.<sup>38</sup> In India, they may be costing the country US\$ 2.5 billion annually – equivalent to approximately 0.4% of GDP.

## Burden on Caregivers and Health Systems

Professional care for disabled children is too costly for most families, so family members dedicate themselves to this care instead of attending school or generating household income. Childhood illness – particularly when bouts are frequent and long – can lead to unaffordable costs for many families, both in terms of drug treatment and productive time lost in caring for the ill. The time and resources of health-care providers spent in the diagnosis and treatment of children who were unable to avoid disease because of vitamin and mineral deficiencies is also significant.

## The Causes of Vitamin and Mineral Deficiencies

As with malnutrition in general, the causes of vitamin and mineral deficiencies are multiple and interconnected.

### Poor diet

The most immediate cause is poor nutrient intake through

inadequate diets. Vitamins and minerals occur naturally in food. A varied diet of meat, eggs, fish, milk, legumes, fruits and vegetables is the best basis for obtaining adequate vitamin and mineral nutrition.

While of fundamental importance, improving the diets of the world's poor is a complex and long-term undertaking that depends largely on rising incomes. In the short term, lives can be saved and improved through a range of cost-effective interventions, including supplementation and fortification.

### Illness

Illness impedes the body's ability to absorb and retain vitamins and minerals. It can even lead to actual losses of them, as in the case of zinc loss during diarrhoeal illness. Vitamin and mineral nutrition is severely compromised by



*A mother in Tanzania breastfeeds her two children. If exclusive breastfeeding is not practised during the first six months of life or if the solid foods introduced after that period are nutrient-poor, young children are also likely to suffer vitamin and mineral deficiencies.*



parasitic infections such as hookworm. A vicious cycle ensues when the deficiencies caused by disease leave the individual more vulnerable to further illness, and less able to combat it when it strikes.

## Underlying causes

Underlying poor nutrient intake and disease are issues of insufficient access to food, inadequate health care, and poor caring practices that inhibit growth and health.

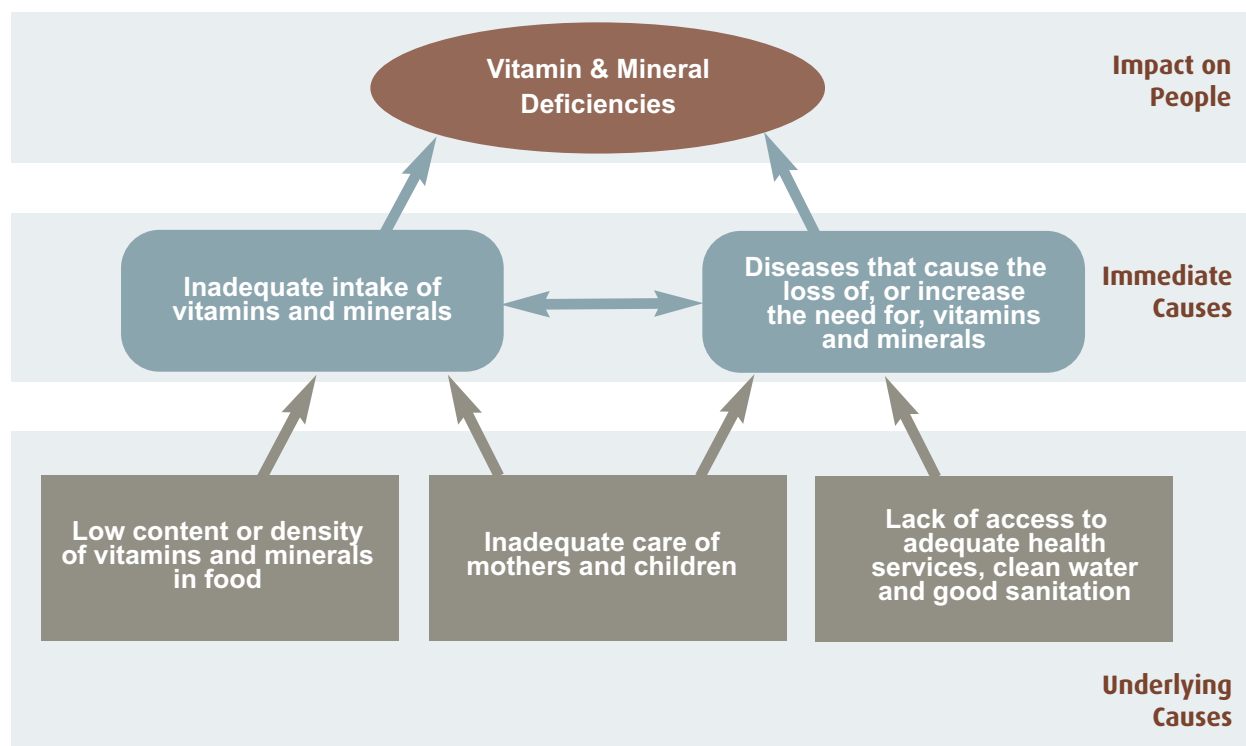
The provision of nutrition and child-care education, particularly to women, is also essential. Among the practices that would pay great dividends for children's nutritional health are:

- ensuring early and exclusive breastfeeding for the first six months of life
- providing nutrient-rich foods, in sufficient quantity and quality once complementary feeding begins
- stimulating infants and young children to encourage physical and cognitive development, and
- timely visits to health service providers for micronutrient supplementation and immunization.

Unfortunately, support for household nutrition and child-care remains out of reach for those who have limited access to health services. Despite the many causes of vitamin and mineral deficiencies and the great challenge posed by the sheer numbers of people affected by them, highly cost-effective solutions exist.

*In 2003 it was estimated that without appropriate interventions, India's productivity losses due to undernutrition, iron deficiency anaemia, and iodine deficiency disorders could equal US\$ 114 billion between 2003 and 2012.*

**Figure 2. The main causes of vitamin and mineral deficiencies**



Source: Adapted from *Determinants of Malnutrition: The State of the World's Children*, UNICEF, 1998

## Refugees and those affected by emergencies are especially vulnerable to vitamin and mineral deficiencies



*A Sudanese refugee seeks shelter from a sandstorm near Tine, Chad. Vitamin and mineral deficiencies can easily develop during an emergency (such as war or a natural disaster). © UNHCR/H.Caux*

Vitamin and mineral deficiencies can easily develop during an emergency – or worsen if they are already present.

In times of war or natural disaster, livelihoods and food crops are lost, food supplies are interrupted, diarrhoeal diseases break out, and infectious diseases suppress the appetite while increasing the need for micronutrients to help fight illness.

Vitamin and mineral deficiencies have been reported for years in emergency settings, especially in refugee camps. For instance, a 2003 study among Burmese refugees in Thailand found that 65% of children suffered iron-deficiency anaemia.

Due to a variety of factors, the delivery of essential micronutrient interventions is especially challenging in emergency settings. Although vitamin A supplements are already routinely included as part of an emergency response, other deficiencies are too often neglected.

However, during the past decade, multiple micronutrient fortification has been used increasingly in these situations. In 2003, mobile milling and fortification equipment was used at the Nangweshi refugee camp in Zambia to fortify maize meal with a number of micronutrients, including vitamin A, folic acid, iron and zinc. A 2007 study found that the introduction of fortified maize meal led to a decrease in anaemia in children and a decrease in vitamin A deficiency in adolescents.

The UN Standing Committee on Nutrition has suggested that a combination of interventions may be appropriate, including increased access to fresh food, improved livelihoods and access to markets, enhanced fortification of food aid, distribution of supplements, and in-home fortification with multiple micronutrient powders or fortified condiments.<sup>41</sup>