Strategies to Combat Hidden Hunger

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Let us remind ourselves at this point once again: The discussion regarding a rise in the production of staple foods is focused on providing sustenance, in other words calories, and not high-quality, nutritious food for the world's growing population. The goal is to avoid potential famines. The guiding principle is that no person should starve. Persons whose hunger is satisfied in this manner still find themselves in a state of undernourishment and susceptible or 'sensitive' to starvation in the words of the FAO, the WHO and other organizations. Sensitive means that a sudden drop in calories could lead to death by starvation.

Starvation in this context means that children die from harmless infections or from childhood illnesses, such as measles, which become too serious for the children to cope with. Starvation also means that the body's reserves are completely depleted and, along with a lack of bodily fluids, food can no longer be properly digested. This is a sort of wasting away which even the most well-intentioned dietary intervention can no longer stop. Such measures are often a more or less brief interruption of a chronic state of undernourishment. The dilemma faced by victims of hidden hunger is slowly being understood. Three years ago, UNICEF identified and documented micronutrient deficiency as being the central issue with regard to the hunger carousel (UNICEF 2009).

The impact of such policies can be demonstrated on board the hunger carousel, as well as the necessary relief measures.

Figure 7.1 shows the impact of hidden hunger on the passengers on board the hunger carousel. We tend to notice people who are starving, visibly emaciated, or show symptoms of a severe vitamin deficiency. We see them as candidates for acute dietary intervention. Those who suffer from the effects of hidden hunger remain in the background since their symptoms, including frequent illness, physical, and mental handicaps, or 'mere' poverty, and lack of education are not seen as being associated with hidden hunger. This is a general fact and not exclusively a developing world problem. It is often just a case of the severity of hidden hunger and thus of the effects. How severe these are to what extent the lives of those who are afflicted by hidden hunger are impacted cannot be estimated. Hidden hunger and its adverse health effects lie tucked away in places where they are least expected.

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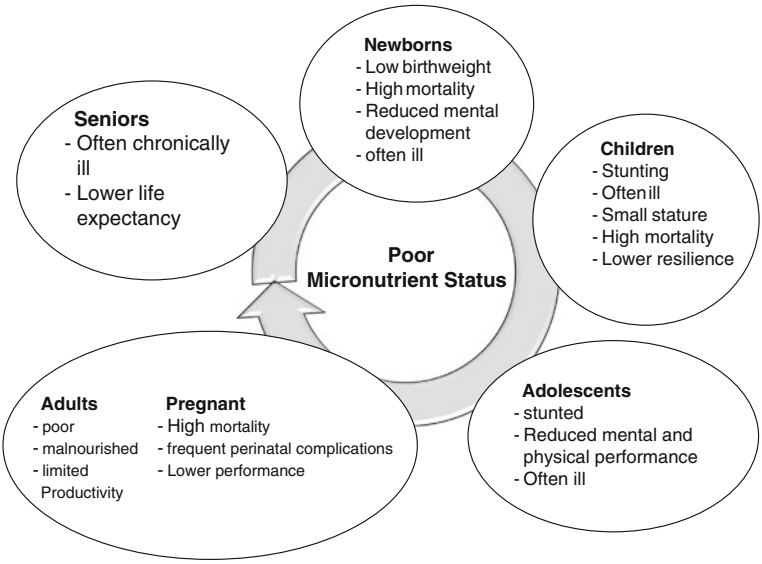

Fig. 7.1 The carousel of hidden hunger (UNICEF 2009)

If dietary intervention is not systematically undertaken at some point within the vicious circle, then the circle begins again at that point with even less of a chance of preventing the complications associated with hidden hunger. Unlike the hunger carousel, which is visible for all to see, the hidden hunger carousel, as the term indicates, is concealed behind the former. If a concerted effort is made to alleviate hidden hunger, many of the related developmental disorders and illnesses will vanish.

The fight against hidden hunger must not be carried out on isolated fronts, but rather attack the circle in its entirety. The goal of all relief efforts must be a healthy and appropriate diet for those who currently suffer from hidden hunger in all age groups. This will ultimately lead to an increase in performance and productivity. The fruits of increased productivity must be reaped solely by those who carried out the necessary labor. This is the gauntlet which has been thrown down to politicians from the regional to the international level, as well as to everyone with regard to their dietary habits since food is a valuable resource and must be treated as such—in every respect. This is the only way to pave the way out of poverty for the poor and to create a framework for reducing hunger and hidden hunger.

Acute Crisis Intervention: Supplements

In the case of hidden hunger, acute crisis intervention means administering specific micronutrient supplements to alleviate a deficiency. Such intervention requires that the deficiency has been diagnosed or is at least highly probable and that an

improvement in one's health status can be achieved by means of supplementation. This is particularly the case with regard to the micronutrients vitamin A, zinc, and iron. Concerning the latter, however, malaria incidence must be taken into account beforehand.

Malnutrition and economic development are closely tied together. In light of this fact, the recommendations proposed by the Copenhagen Consensus (2008) are to be understood as a vital means of increasing productivity with the help, for instance, of vitamin A and zinc supplements.

The considerations by the members of the Copenhagen Consensus are based upon studies which have shown that administering protein and micronutrient supplements to malnourished children helps to improve not only physical and mental development, but also their level of productivity. The latter can be observed from the disparity in the average income of adults who, as children, received supplements versus those who did not. A cost-benefit analysis was conducted at the same time to determine what the potential success of implementing these measures would be.

For that reason, a catalog of criteria was assembled which should help to make improvements in the health and productivity of hungry persons more effective. The disability-adjusted life years, or disease-adjusted life years (DALY) values are incorporated into this. These are the years of productivity which are lost due to premature death or disability in relation to life expectancy. It is possible to project the degree to which the DALY values can be reduced by implementing the measures to reduce hidden hunger. Recommendations are made based on the relative costs of the various measures and their potential to reduce the DALY values. This is admittedly a very bureaucratic approach which pits finances against benefits. If intervention is not found to help reduce the DALY values or sufficiently increase productivity relative to what it costs, then it no longer becomes an option. The fact that the particular deficiency is often not questioned, for example if a person suffers only from a vitamin A deficiency or from a lack of iron, or indeed a number of other vital nutrients as well, may be tied to certain (economic) constraints which measures which are aimed at intervention are subject to. For the individuals concerned, it matters more to them if their situation will improve or not and less if their productivity will have a measurable impact on the economy. This issue is undoubtedly relevant to fighting poverty, yet it must not be misunderstood as being a long-term or sustainable approach to the problem. The Copenhagen Consensus also issued a statement declaring supplements to be a form of crisis management and not a long-term solution to hidden hunger.

The participants of the Copenhagen Consensus 2004, the most highly renowned economists, were determined to define criteria by which the economic power of poorer countries could be strengthened. Their proposals, which were amended in 2008 and 2012, can be interpreted as a combination of immediate and mid-term solutions.

The result is a catalog of measures (see Box 7.1), whereby half of the first ten of which are related to nutrition. Without a doubt, the criteria contained in the Doha Development Agenda, which were established by members of the WHO in Qatar

in 2001 and which have so far failed to be implemented due to resistance by industrialized nations, are designed to improve the position of developing countries in the global marketplace. Fulfilling these criteria is indeed a prerequisite for developing countries to make economic progress and comply with the demands of the Copenhagen Consensus.

Box 7.1 Copenhagen Consensus (2008)

1. Micronutrient supplements for children (vitamin A and zinc)
2. The Doha development agenda
3. Micronutrient fortification (iron and salt iodization)
4. Expanded immunization coverage for children (e.g., measles, tetanus)
5. Biofortification
6. Deworming and other nutrition programs at school
7. Lowering the price of schooling
8. Increase and improve girls' schooling
9. Community-based nutrition promotion
10. Provide support for women's reproductive role.

Why are vitamin A and zinc supplements at the top of the list? This is because vitamin A and zinc cannot be obtained from food in adequate amounts by those who desperately need these micronutrients quickly enough. Achieving this is a necessary precondition for eliminating hidden hunger worldwide. By means of vitamin A and zinc supplements, the under-four mortality rate can be dramatically reduced by between 20 and 40 %. It is also possible to achieve a 70 % reduction in blindness and an estimated 30 % reduction in diarrhea among children. At the same time, supplements can help to break the vicious circle described earlier and improve children's at-home care. Similarly, improving mothers' iron status can help to reduce maternal mortality.

The effectiveness of vitamin A supplements can be seen from the figures which were recently obtained as the result of a nationwide supplementation program in India. The is a significant correlation between the reduction in mortality among children between the ages of 5 months and 6 years and the pervasiveness of supplement programs (Semba et al. 2010).

Should one wish to consider to what extent intervention in the case of a vitamin A deficiency is economically 'sensible', the figures indicate that preventing death through vitamin A is relatively 'cheap' compared with preventing death by other means (see Table 7.1). Oral rehydration therapy (ORT), which alleviates diarrhea caused by a zinc deficiency, is the most expensive form of intervention.

The third point on the Copenhagen Consensus' agenda is micronutrient fortification of staple foods, such as iron and salt iodization in combination with vitamin A supplements. Such emergency treatment could be applied to target and fight hidden hunger. In the long run, however, food products which naturally contain essential micronutrients must be made available to the poor as the

Table 7.1 Costs of intervention (to prevent fatalities) (WHO 2008)

Vitamin A supplements	$23
TB treatment	$50
Malaria treatment	$145
Measles vaccination	$243
ORT for diarrhea (children)	$3,401

Copenhagen Consensus also demands. This can be achieved by means of genetically modified foods, such as golden rice, and particularly through biofortification, involving the cultivation of varieties which have a high concentration of specific micronutrients. In both cases, the first steps have been taken and appear thus far to be very promising. An example of this success is the significant improvement in the bioavailability of β-carotene in golden rice, which has essentially turned golden rice into a sound source of pro-vitamin A. In addition, there are also a number of varieties of rice on the market which have been cultivated to contain more β-carotene.

The Copenhagen Consensus 2012 Expert Panel took a strong stand on hidden hunger and believes that fighting malnourishment should be the top priority for policy-makers and philanthropists, as is evident in the summary given by the Nobel laureate economist Vernon L. Smith:

> One of the most compelling investments is to get nutrients to the world's undernourished. The benefits from doing so—in terms of increased health, schooling, and productivity—are tremendous. (Vernon Smith 2012).

From the 16 items which were found by the group to be worthy of investment in 2012, the first and most desirable one is bundled micronutrient interventions to fight hunger and improve education. By doing so, the group has distanced itself from supplements containing only vitamin A and zinc. This does not imply, however, that these should be discontinued in the future. Rather it is apparent that a combination involving other micronutrients is more effective. To provide a child with micronutrient supplements and food, treatment for worms and diarrhea, and special care programs would only cost $100.

Therapy During the 1,000-Day Window

It has been repeatedly mentioned that the so-called 1,000-day window is the critical period regarding the adverse effects of malnourishment (see Chap. 3). That is why special attention is paid to this time period when intervention therapy is administered. Naturally, the best therapy would be a balanced diet, which (still) fails for a variety of reasons mentioned at length in the previous chapters. During the first stage of life, the 2012 UNICEF report recommends the following measures and mentions the benefits of doing so:

- *Early breast feeding*. Breast feeding within the first hour after birth reduces the risk of neonatal mortality by 20 %. Worldwide, more than 40 % of all newborn infants are not breastfed during the first hour.

- *Exclusive breast-feeding*. Less than 40 % of all infants worldwide are breastfed for less than six months. A child who is not breast-fed has a 14-times greater risk of not surviving its first six months than one who is exclusively breast-fed.
- *Continued breast-feeding*. In developing countries, three out of four children are breast-fed during the first year, but only one out of two children is breast-fed during the second year.
- *Baby food*. Giving a child baby food during the first two years ensures that the child receives an adequate diet and, therefore, is most effective for preventing stunting and promoting the child's healthy development.
- *Micronutrients*. Vitamin A is recommended. One in three children does not receive vitamin A supplements twice a year.

With regard to the hunger carousel, improving a person's micronutrient status by means of micronutrient supplements as a form of crisis intervention at the outset of the 1,000-day window appears to be the best approach. The recommendation to breast feed is certainly sensible, yet it does not take into account two important aspects: There is insufficient scientific data regarding the concentration of micronutrients in breast milk during the baby's first six months, particularly when the mother is malnourished. This is especially critical when the intervals between births are short, as is common in Asia and Africa. In 25 % of cases in Europe, the concentration of vitamin A in mothers' breast milk was at a critically low level (Strobel et al. 2007). This can be the result of a multiple birth or short periods in between births. Expecting mothers who have a balanced diet and come from a higher social class in Germany were observed to have vitamin A concentrations in their blood which can be classified as being borderline deficient (<1.4 umol/l), whereas in the blood of the umbilical cord, the amount was clearly deficient (<0.7 umol/l) in 27 % of cases (Schulz et al. 2007). The retinol levels in the colostrum were found to be significantly lower among mothers who had given birth to twins than among women who had not undergone a multiple birth (2.35 and 4.15 umol/l respectively). A plausible explanation for the alarmingly low concentration of vitamin A in these women's breast milk is an unbalanced diet (e.g., lacking meat, particularly liver). The intake of pro-vitamin A by eating fruits and vegetables is apparently insufficient for maintaining an adequate vitamin A status. What the vitamin A status of children whose mothers are substantially malnourished is during their first six months can hardly imagined. The same applies to the other micronutrients. More specifically, young girls who are malnourished and could potentially become pregnant should receive micronutrient supplements. Such measures should always be coupled with education about nutrition. A number of studies were conducted which involved administering supplements of folic acid and iron, or a placebo to expectant mothers at various intervals. The results were then compared in meta-analyses. As heterogeneous as they were, the results do, however, open the door to new questions and approaches. A meta-analysis which comprised 17 studies tested whether the administering of bundled micronutrient supplements versus iron and folic acid to expectant mothers was beneficial (Haider et al. 2011). In both cases, a significant reduction in anemia during the third trimester was observed. This confirms the results of other studies,

which showed that anemia could be reduced among women with multimicronutrient supplements. However, there was still a not inconsequential number of women (25–35 %) whose anemia could not be cured. There are apparently other dietary factors which play a part in anemia and could not be compensated for by means of supplements.

The children of women in the multimicronutrient group did however have a much lower tendency to be underweight than those of women in the folic acid and iron group. Especially important with regard to this result is the fact that this primarily applied to women whose BMI was >22, in other words, whose diets seemed to be adequate. And yet, it should be clear from the previous chapters that this fact does not necessarily mean that the micronutrient status of the mothers was sufficient. This could explain the effect of the bundled micronutrient supplements. An observation of the children throughout the entire 1,000-day window was only carried out in one study (Huy and Le Hop 2009). In the study, pregnant women in two different districts in Vietnam were given either multimicronutrient supplements plus antenatal classes (MMN+A), or multimicronutrient supplements (MMN) or folic acid and iron (FI) without antenatal classes. Dietary counseling was provided to all three groups. In the two groups which had been given multimicronutrient supplements, the birth weight of the children was significantly higher (MMN 166 g; MMN + A 105 g) than in the folic acid and iron group. The children in the MMN groups were also taller at the end of their second year (MMN 82.66 cm; MMN + A 83.61 cm; FI 81.64 cm). The percentage of children with stunting was also 10 % lower in both MMN than in the FI group (20 versus 30 %). The number of children with anemia was only half as high in the MMN groups (43) than in the FI group (95).

This study illustrates two important aspects. Providing MMN to expectant mothers results in a better micronutrient status for their children and, thus, a better development, although not in every case, as the stunting figures show. This fact, together with the high anemia rate, indicates that the children's diets were inadequate during their first two years. Bundled micronutrient supplements are, therefore, only a partial solution. Hidden hunger must be treated before conception so that both mother and child are well-supplied with micronutrients during pregnancy and lactation. The fact that breastfeeding is beneficial to babies' diets, also as a dietary supplement, even after their first six months, requires no further explanation.

Box 7.2 Long-term Studies into Intervention: INCAP and CSRP

Both of these studies illustrate the importance of ensuring that children are adequately nourished from the very beginning in order to ensure that they will experience a normal development beyond the 1,000-day window. They have been going on for many years and have provided a great deal of insight into the causes and effects of malnutrition, which, in turn, has been useful in developing new intervention techniques. Since data is continuously being

collected from the children taking part (and has already appeared in more than 30 publications), many conclusions can by drawn concerning the impact of nutrition on a person's development. The Institute of Nutrition of Central America and Panama, or INCAP, which began already in 1949 (Scrimshaw 2010), observed during long-term studies involving supplements that the major factor restricting growth is the amount of protein consumed during childhood. The Collaborative Research Support Program, CRSP, tested without the use of supplements over the period of a year if insufficient energy intake is the primary limiting factor regarding growth and development. The CRSP applied a classical, quantity-based approach, which primarily assessed foodstuffs based upon their calorie content. However, the intake of micronutrients was also captured in the findings.

The INCAP study, which was conducted mainly from 1969 to 1977 with a series of follow-up studies from 1988 to 2007, examined the impact of a marginal case of malnourishment on development, both during childhood and later in adulthood. The scientist who initiated the study, Moises Béhar, wanted to test the impact of malnourishment on children's physical development. In order to also be able to observe the cognitive impact, Josquin Cravioto, a renowned expert in this field, was added to the team.

Together, the CRSP study, which involved children in Kenya, Egypt, and Mexico, and the INCAP study are two of the most comprehensive studies to have dealt with these issues.

So what answers did the study deliver concerning how stunting among children could be explained and how this affects further development, including cognitive ability? Neither the protein supplements administered in the INCAP study, nor the calories obtained in the CRSP study were able to prevent children from being stunted. Thus, the authors of the INCAP study believe that neither an increase in protein nor a relatively higher consumption of calories can substantially reduce the risk of stunting. In the CRSP study, 65 % of calories consumed by the children were derived, on average, from corn, wheat and rice. The INCAP study did not capture any such data. The majority of children who participated in the CRSP study did not obtain adequate amounts of micronutrients. In all three countries of the CRSP study, between 38 and 45 % of the children suffered from iron deficiency anemia. INCAP also estimates a similar figure, due to the high percentage of corn in the children's daily diets, although this issue was not specifically examined in the study. Other micronutrients were found to be at critical levels (Mexico: vitamin B12, 44 %; vitamin E, 85 %; zinc, 57 %; Egypt: vitamin B2, 52 %; vitamin C, 63 %; vitamin A, 20 %; vitamin E, 92 %; iron, 88 %; zinc, 25 %; Kenya: vitamin B2, 20 %; vitamin E, 22 %; iron, 65 %; zinc, 10 %) The amount of animal-based products, such as meat, eggs, and dairy products, which are sources of the above-mentioned vitamins, made up between 11 and 15 % of people's diets in all three countries. It is, therefore, not surprising that the children's micronutrient intake was

insufficient. Children's growth rates in Kenya and Mexico correlated directly with the amount of animal-derived foods consumed. Lindsay Allen (1995), one of the directors of the CRSP study, came to the conclusion that stunting and developmental handicaps suffered by children in Guatemala and in the three countries in the study are caused to a greater extent by a lack of micronutrients than by a lack of energy or protein. More precisely, she believes that it is the key micronutrients in hidden hunger—iron, zinc, and vitamin A—which have a significant impact on physical development.

INCAP and CRSP have reconfirmed that growth during a baby's first 1,000 days is decisive and that a child's height at the end of his or her second year has a direct impact on his or her height as an adult. As previously described, this fact has implications for a society's labor force and future development.

Improving the Quality of Food (Nutritiousness)

Creating new sources of micronutrients can only be, at best, a mid-term solution since only very few micronutrients can be replaced by others. On a long-term basis, people's nutritional requirements can only be satisfied by dietary means, in other words with food, whose components can, by all means, be fortified with vitamins, minerals, etc.

The most sustainable way to improve the nutritiousness of food is to raise the diet diversity score by increasing the assortment of foodstuffs available. To accomplish this requires not only the necessary financial means, but also basic dietary knowledge. There is no miracle cure. Each food product must be put to the test to examine how it satisfies a person's dietary requirements. Based upon the results, recommendations can then be made for combining various foods to achieve the nutritional target.

Recognizing Malnutrition: Case Study Indonesia

According to a survey which was conducted among 68,000 households in Indonesia in 2008, the average person consumes 102 kg of rice per year. Rice thus accounts for 60 % of the daily caloric intake of 2,450 kcal. On the basis of linear programming, the amount of micronutrients was able to be determined (Jati et al. 2012). The typical diet of children between the ages of two and five is illustrated in Table 7.2. The table does not account for differences in social class.

Based on these data, the foods necessary to provide sufficient amounts of vitamin A, zinc, and iron can be ascertained. At the same time, it can be determined how much of these micronutrients are necessary to meet the recommended intake (see Fig. 7.2). Using special algorithms, the data which has been collected from nationwide dietary studies can be used to assess the amount of micronutrients consumed from each of the food groups which contain those particular

Table 7.2 Dietary breakdown for children ages 2–5 (Jati et al. 2012)

Food	g/day	kcal
Rice	225	790
Vegetables/beans	44	33
Meat/chicken	40	104
Fish	24	27
Eggs	60	82
Fruits	40	34
Total		1,070

micronutrients. Dietary models containing locally produced food items can be compiled and thus contribute to improving the micronutrient status of the population.

On the basis of such analyses, it is not only possible to determine the degree of micronutrient deficiency within a given population, but it is also possible to present recommendations for targeting and removing such deficiencies. Much has already been accomplished, for instance, by substituting one portion of white rice

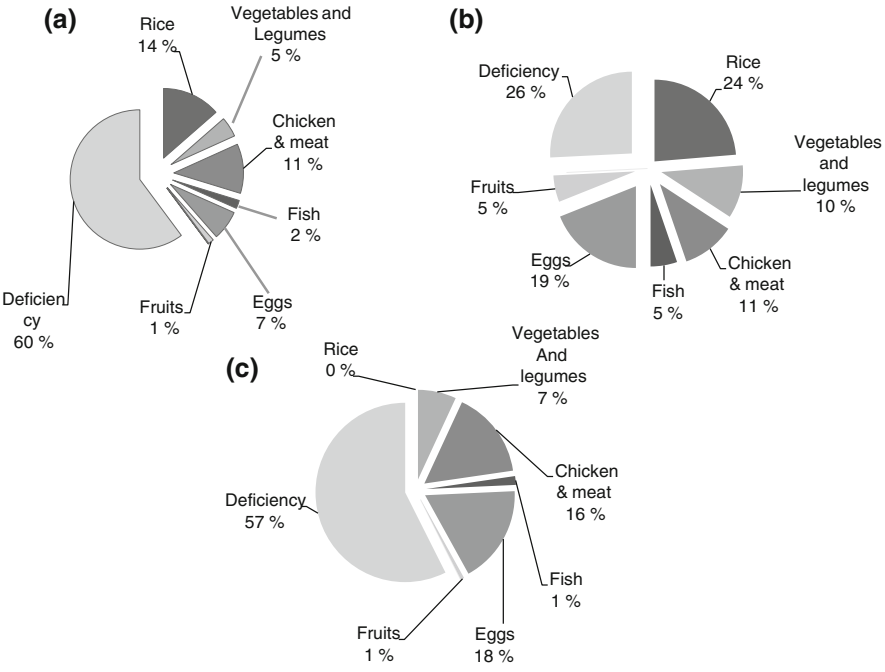

Fig. 7.2 Average diet of children and its content of iron (**a**), zinc (**b**) and vitamin A (**c**) in % of RNI. The depiction of the individual food groups allows nutritional gaps discovered during treatment to be filled

with sweet potatoes or more nutritious, colored varieties. Spinach and fruit, as well as palm oil can also make valuable contributions to diet optimization. The great advantage of such analyses and recommendations is the fact that not only more traditional foods and those which are only available in certain regions are taken into account, but also those which are affordable.

UNICEF and the World Bank, in cooperation with important organizations in the field of food security, including USAID, GAIN, the Micronutrient Forum, and the Flour Fortification Institute, published a World Report which states that certain micronutrient supplements should be considered as a means of achieving the MDGs (SUN 2010). Table 7.3 shows the different micronutrients and their role in the MDGs.

Systematic supplementation in countries affected by hidden hunger can lead to an accelerated strive toward reaching the MDGs. The question is whether this approach will enable mothers to get off the hunger carousel and secure a better prospect for themselves and their children. As mentioned previously, the occurrence or rather the diagnosis of an isolated micronutrient deficit is an indicator of a

Table 7.3 Requirements for food security (SUN 2010)

Millennium development goal	Role of micronutrients
MDG 1: The eradication of extreme poverty and hunger	Iron can eliminate anemia, and increase productivity and income Salt iodization reduces the risk of iodine deficiency, increases the prospects of receiving an education, pursuing a career and earning a decent income Zinc reduces the risk of stunting and its adverse effects
MDG 2: Primary school education for all	Salt iodization improves cognitive development Iron improves cognitive development among children Zinc reduces illness and therefore absenteeism at school Vitamin A prevents blindness Folic acid prevents developmental disorders
MDG 3: Gender equality/ strengthening the role of women	Iron increases productivity among women The treatment of malnutrition among women has a greater effect than among men: an improved micronutrient status can help to neutralize inequality with regard to access to adequate and nutritious food
MDG 4: A reduction in the infant mortality rate	Vitamin A significantly increases a child's chances of survival Zinc reduces cases of diarrhea, one of the main causes of child mortality Salt iodization reduces iodine deficiency and thus the occurrence of birth complications, stillbirths, and neonatal deaths
MDG 5: An improvement in mothers' state of health	Iron increases a mother's chances of survival Salt iodization minimizes the effects of iodine deficiency, including miscarriage, stillbirth and congenital mental handicaps and deafness

generally inadequate diet. Therefore, further deficits, which receive even less attention as a result of the focus given to the diagnosed deficiency, still lurk in the background, resulting in health complications and reduced labor capacity.

The risk involved in the supplementing of individual vitamins and minerals is that other contributing factors to hidden hunger, i.e., other micronutrient deficiencies, may be overlooked. For that reason, more bundled micronutrient supplements are being called for (Semba et al. 2011). These can take the form of a powder to fortify one's daily diet or to complement so-called ready-to-use therapeutic foods (RUTFs), or energy-dense, micronutrient-enriched pastes which can be produced locally. Doing so requires more cooperation and diligence on the part of the victims as opposed to programs whereby, for instance, high concentrations of vitamin A are administered twice a year.

The governments of Japan and Canada in cooperation with the World Bank and USAID started an initiative in 2010 to promote scientifically proven supplementation programs. Among these were:

- periodic vitamin A supplements,
- zinc supplements in cases of diarrhea,
- micronutrient powder to fortify meals,
- iron-folic acid supplements for expectant mothers,
- salt or oil iodization,
- iron fortification of staple foods.

Those who initiated these recommendations were well aware of the fact that they do not solve the problem completely and therefore put forth proposals for further action.

Mid-Term Solutions

Sustainable, mid-term solutions are those which more or less compensate for micronutrient deficiencies. These include RUTFs, RUSFs (ready-to-use supplementary foods), micronutrient supplements, such as sprinkles, or enriched foodstuffs by means of cultivation or genetic modification, e.g., corn, rice, sweet potatoes, or oil.

Fortified Food Products

Most products which are enriched with micronutrients are staple foods, such as flour, sugar, salt, or oil, in order to reach as many people as possible. The most well-known example is iodized salt, which is the standard salt in many regions and is even required by law in some countries. In the United States and Canada, as well as a few other nations, folic acid is added to flour and milk is enriched with vitamin D.

Nutrient enrichment of food of which roughly the same amount is consumed daily is a sensible measure. One important condition is that neither the taste, nor the appearance, nor the price is affected in the process. The latter is often the most uncertain factor, the reason why many sensible projects, such as the enrichment of oil with vitamin A, have failed. For that reason, it must be considered if an alternative exists which naturally contains the respective micronutrient, for instance using palm oil, which contains vitamin A, instead of vegetable oil.

Since deficits occur at varying degrees in different countries, different foods are enriched or perhaps none are enriched at all in the respective countries. The most widespread form of nutrient fortification is salt iodization. In light of the fact that hidden hunger is a problem in developing countries, test fortification schemes have been conducted in individual regions, including adding vitamin A to vegetable oil and sugar, iron to fruit juice, rice and sugar, and zinc to fruit juice, rice, and cheese. In industrialized countries, especially the USA and Canada, milk and dairy products are enriched with vitamin D and folic acid is added to flour. The latter has contributed to a significant reduction (50–80 %, depending on the region) in so-called neural tube defects, involving an opening in the spinal cord or brain, among newborn infants (Lindzon and O′Connor 2007). In the case of iodine, vitamin D, and folic acid, we are dealing with worldwide deficits. The same applies to iron, however since this deficiency usually affects females, a general enrichment of food with iron has not been recommended. There are a number of other nutrient-enriched foods which are available in certain regions, such as vitamin A-enriched mustard in India. However, such products are not affordable for the poorer members of society, with the exception of iodized salt, or many people are not aware that such fortified products are available. On the other hand, there are indeed regions which have reported success in fighting hidden hunger by means of nutrient enrichment. A ready-made mixture of iron and vitamin A was added to the portion of rice eaten by children ages 36–66 months over a period of 24 weeks. In comparison to the group of children which had received rice without any nutrient additives, a significant reduction in anemia, yet not in vitamin A deficiency, was observed (Varma et al. 2007). The enrichment of cooking oil with vitamin A over a period of 18 months led to a clear reduction in the prevalence of vitamin A deficiency (<10 %), while the standard practice of administering a vitamin A capsule showed no significant effect. The rate of occurrence remained at 30 % (Mason et al. 2011). There is a well-known problem inherent in the latter practice. The explanation could be poor bioavailability since fat is lacking, or perhaps intestinal parasites and diarrhea prevent the vitamin from being absorbed. Enriching foods, on the other hand, involves a continuous administering of vitamin A in small doses, yet dissolved in oil.

A study involving cornmeal showed that when it was enriched with vitamin A, B1, B2, and B6, a substantial improvement in vitamin A status was experienced by 21 mildly malnourished children, in comparison to 23 mildly malnourished children who consumed normal cornmeal used for making porridge by adding milk or water (Nesamvuni et al. 2005). Children in both groups experienced the same

increase in height and weight over the entire time period of the study. This was especially the case with severely malnourished children. The study worked with very small collectives and also did not account for illnesses which require more vitamin A, which means that the results are not particularly reliable. The authors do point out, however, another issue regarding enriched foodstuffs. Many of the children between the ages of 12–18 months were breastfed. Thus, the amount of cornmeal porridge which they ate varied greatly. As the frequency of breastfeeding decreased, the children were given more cornmeal and other low-vitamin A foods. When the porridge is prepared by means of cooking or simmering for up to 30 min, half of the vitamin A which was added (1,700 IU in 150 g) is destroyed.

Nevertheless, there are a number of foodstuffs, in addition to salt and flour, which have been tested and found to be ideal candidates for nutrient enrichment (see Table 7.4).

Nutrient-enriched oil promises to be a booming business. Cargill, a major American food manufacturer, has begun to enrich oil made from soybeans, sunflowers, cotton, mustard, and peanuts with micronutrients, especially vitamin A. It is hardly available for the poorer members of society, however, because it is relatively expensive. What is more, oils which are refined are more expensive and lose important substances, such as fat-soluble vitamins in the process. Nonrefined palm oil retains its pro-vitamin A and vitamin C and is an important source of vitamin A and E for the poor, provided the price remains stable. When foods are biofortified, with the noble purpose of reducing micronutrient deficits, it must nonetheless be asked which corporate interests are behind the initiative, which traditional foodstuffs are being sidelined ,and what sustainable contribution is really being made to food security.

Enriched foods can be a valuable solution if they are available to everyone, including the poor, and particularly to children aged 6 months and older. The problem lies in overseeing the distribution so that it is uniform and widespread. In addition, price stability can hardly be guaranteed. The persons who own the mills where food is enriched also want to survive and are dependent upon the price of raw materials.

Table 7.4 Fortification of food with micronutrients

Food	Enrichment
Rice	Vitamin A, E, B1, B12, niacin, folic acid, zinc, iron, selenium
Oil	Vitamin A (perhaps vitamin D and E)
Sugar	Vitamin A, iron, zinc
Fish sauce	Iron (Vietnam)
Soy sauce	Iron (China)

Ready-to-Use Therapeutic/Supplementary Food

RUSFs were designed to ensure that children suffering from chronic malnourishment received enough micronutrients and protein. Mixtures of special micronutrient supplements called sprinkles are then added to these. Sprinkles are also added to food in the form of small globules and provide a multitude of vitamins and minerals.

It was observed in a comprehensive meta-analysis that this form of intervention helps to reduce the prevalence of anemia among children under the age of two by up to 50 % (De Regil et al. 2011). As mentioned earlier, anemia is not only symptomatic of an iron deficiency, but it is also an indicator of a more or less extreme case of malnutrition.

RUSFs have many important benefits, which make them suitable even under adverse conditions. They need not be kept cool and kept even in high temperatures. They also need not be mixed with water and this reduces the risk of bacterial contamination. Hence, they are effective on a mid-term basis for preventing severe malnutrition.

RUTFs are also specially designed to treat acute and severe malnutrition among children. An intervention study which was conducted in 12 villages in Niger clearly illustrates the previously described causes of malnutrition and the difficulties involved in treating the ensuing health complications (Isanaka et al. 2009). The control group contained six of the villages. In the other six, a three-month supplementation program using RUTFs was carried out, as well as follow-ups which monitored weight and height. 11 % of the children were found to be severely malnourished, whereby the figures reach a peak around the time just before the millet harvests in August, when supplies are just about empty.

The supplements lead to a rapid growth in weight versus height (WHZ) in comparison to the control group. At the beginning of the study, the degree of wasting in the control group increased significantly (i.e., a higher z-score), whereas in the test group there was little change and less severity if a change did in fact occur. This illustrates the success of intervention in cases of mild malnutrition (z-score < -1.5). At the same time, however, there was no apparent difference in the morbidity rate for malaria, diarrhea, and respiratory infections. In the test group, seven children died, whereas 18 children died in the control group.

A look at the figures for growth as an indicator for stunting shows the limits of supplementation. All children were clearly stunted (z-score > -2.0) at the outset of the study. The children's growth in the test group was only marginally improved through dietary intervention. This demonstrates the fact that this form of intervention is too late (i.e., after their second year) to be of any benefit to many children and is also ineffective in preventing stunting related to chronic malnutrition during early development. The authors of the study (De Regil et al. 2011) come to the conclusion that this form of intervention can lead children who suffer from mild malnutrition to gain weight, yet it cannot shield them from the causes nor prevent them from suffering the later effects of chronic malnutrition.

In a follow-up study (Isanaka et al. 2010), the authors assessed the success of Plumpy Nut, an enriched peanut butter paste, as an RUTF versus an RUSF, which is not intended to be an emergency measure, but rather a supplement to one's daily diet. In comparison to RUTF, RUSF only contains half the amount of calories, yet it has a higher concentration of micronutrients per 500 kcal. RUSF are also not intended to replace meals, but rather to fortify them. RUFS was administered over a six-month period, clearly longer than that of RUTF (four months). This may explain why in the RUSF group the stunting rate among children was 19 % lower than in the RUTF group and why the mortality rate in the RUSF group (10 from 747 children) was also clearly lower than in the RUTF group (25 from 856 children).

Conclusion

RUTF and RUSF are important forms of treatment, both as an emergency measure in cases of severe malnutrition, as well as chronic undernourishment. As a form of treatment for chronic undernourishment, they should be a mid-term solution administered in combination with other dietary improvement measures. It is especially important that mothers receive dietary counseling in addition to efforts to improve the availability of different foods. It has been proven in our own studies aimed at improving nutrition that this approach, which goes above and beyond the sole use of RUFS, is both effective and sustainable (Purwestry et al. 2012). The goal of dietary intervention must be the eventual replacement of RUFS with normal, nutritionally adequate food. To achieve this requires knowledge of nutrition, which is often absent among women and must therefore be communicated.

Ways of Getting Off the Hunger Carousel

If the aim is to enable those who are currently on board the hunger carousel to get off once and for all, then this can only be achieved when an entire generation is not hampered by malnutrition and when other supportive measures are undertaken (health care, hygiene, education, minimum wage) in order to lay the foundation for a healthy and productive society. Since such relief measures are often undertaken piecemeal, success is usually short-lived. Even if the maternal and child mortality rates are able to be reduced, a large assembly of vulnerable individuals still remains on board the hunger carousel.

Stunting as a sign of early childhood chronic malnutrition and as a basis for a person's entire development must be attacked at the roots, i.e., during the 1,000-day window.

There are essentially two basic approaches for enabling individuals to leave the hunger carousel forever:

- preventing chronic malnutrition among mothers and their children during the 1,000-day window,
- dietary intervention or the continuation of preventative measures beyond the 1,000-day window.

Prevention

Save the Children compiled a list of measures which should help to lower not only child mortality, but also the rate of stunting in particular.

- iron and folic acid supplements for mothers
- consistent breastfeeding during the first six months and beyond as an additional source of nutrition after weaning

Breastfeeding is without doubt one of the foremost methods for reducing child mortality. If all children were to be breastfed for their first 6 months, the number of children who die each year in developing countries would decrease by 1 million. If newborns were provided with other necessities, such as additional breastfeeding after the first six months, vitamin A and zinc supplements, multimicronutrient powder, as well as clean water and proper hygiene, the lives of a further 1.2 million children could be spared (Save the Children Nutrition 2012).

The assumption that breast milk can supply a baby with all of the necessary micronutrients may be true if the mother herself is adequately nourished, but it is more than doubtful if this is not the case. To date, there have been nearly no studies to compare the micronutrient content of breast milk from well nourished and malnourished mothers. The only isolated studies which have so far provided data involve vitamin A, E, pro-vitamin A, B12, zinc, copper, and iron.

In a study involving 102 nursing mothers from the United States, it was thus revealed that the concentration of zinc in breast milk decreases during lactation from 500 μg/100 g at the beginning to 290 μg/100 g when the breast milk is mature (Feeley et al. 1983). Iron and copper concentrations, however, only decrease during lactation by nearly 20 %. Another study involving 59 women from Vietnam, whose daily iron and zinc intake—primarily from plant-based sources—was 10 mg each and hence under the recommended amount of 30 and 15 mg respectively, revealed that 39 % of these women were anemic, while 55 % had a low plasma zinc level, and that the concentrations of these elements in their breast milk were clearly below those of healthy American mothers six to twelve months after birth. The iron concentrations among the Vietnamese women were 43 μg/100 g versus 76 μg/100 g among the American women, whereas zinc concentrations were 56 μg/100 g versus 290 μg/100 g (Nakamori et al. 2009).

With regard to vitamin A in particular, a number of intervention studies have been conducted to test whether or not supplementation immediately after delivery results in a rise in the amount of vitamin A in the breast milk and the curing of the mother's vitamin A deficiency. In a study involving Nepalese women with varying degrees of vitamin A deficiency, it was observed that both one-off vitamin A

supplements (60,000 RE) and daily pro-vitamin A supplements (7.8 mg/day for the first nine months after birth) did not yield any positive results. The concentration of vitamin A in the breast milk did in fact rise significantly (three months after birth) in comparison to the control group, yet it had dropped again to the same level as that of the control group by month six. In contrast, the pro-vitamin A group experienced no change in vitamin A concentrations in the breast milk during the first six months, yet a sharp rise in vitamin A concentrations occurred after nine months compared with the control group (Rice et al. 1999). Since the women had very little vitamin A stored in the liver, there was apparently not enough of the vitamin to be distributed to the breast milk. The facts of the case also illustrate that since the vitamin A values of the breast milk rapidly declined, the initial supplements were already 'exhausted'.

Ninty expectant mothers from Tanzania were put into groups of three and were given either pro-vitamin A-rich palm oil or sunflower oil (which contains little pro-vitamin A) or green leafy vegetables beginning in the third trimester. Approximately 60 % of the women had vitamin A values which, according to the WHO, are indicative of a vitamin A deficiency. The results indicate that a significant increase in the pro-vitamin A concentration in the mother's breast milk could be achieved by consuming red palm oil. The effect on the vitamin A concentration, on the other hand, was minimal. The drop in the vitamin A concentration in the breast milk which occurred in the group which had not received red palm oil did not occur in the group which had been given supplements (Lietz et al. 2001). The issues involved in providing mothers and their children with adequate amounts of vitamins throughout the 1,000-day window are discussed on page nn.

If a mother's diet is inadequate during pregnancy or if she becomes pregnant in short intervals, the risk is high that the baby will develop a micronutrient deficiency during the time until it is weaned if it is fed exclusively breast milk. If the mother is suspected to suffer from malnutrition, then the better choice would be for her to take bundled micronutrient supplements instead of single vitamin A and iron supplements, naturally under the condition that an adequate diet for her is not feasible.

Intervention

Early prevention should ensure a newborn's survival and guarantee that the child enjoys an adequate diet to enable it to experience normal development. Chronic malnutrition must be prevented with sustainable measures. In addition to the criteria for food security, other factors which promote malnutrition must also be taken into account.

So-called multisector design projects, which comprise various subprojects to capture data concerning childhood development, provide valuable input as to how intervention can be optimized. These include:

- Food security within the household
  - dietary adequacy month by month;
  - food processing;
  - number of meals;
  - diet diversity score.
- Childcare
  - breastfeeding;
  - medical treatment in case of fever or coughing;
  - vitamin A supplements.
- Monitoring for infectious diseases
  - use of insecticide-impregnated mosquito nets (to prevent malaria);
  - availability of clean water;
  - access to clean sanitary facilities;
  - monitoring for diarrhea;
  - measles vaccination.

These measures were applied in 8,652 households (70 % of which had an income of <$1/day; average size 5.9 persons; 95 % rural; 16 % with a school diploma) in nine African countries over a period of 3 years. In the end, data from 2,700 households was able to be evaluated. Improvements were observed in all three sectors, meaning that substantial improvements were achieved regarding food security and diet diversity. Regarding childcare, improvements in all three areas were observed, as well. Yet, improvements in the monitoring of infectious diseases were not observed to the same degree as in the other sectors. The unchanged prevalence of diarrhea is an indicator of the still relatively poor hygiene. The height of 1,096 children was measured at the end of year three. After income and demographic variables were factored in, the prevalence of stunting was 43 % lower than the initial values. By applying the above-mentioned measures, stunting was able to be significantly reduced and this underlines the value of multisector projects, and also illustrates how comprehensive this form of intervention must be. Despite the success of such projects, however, the prevalence of stunting continues to increase in the countries where the studies took place (see Fig. 7.3).

The yearly progression of the stunting rate can be viewed as a seismograph with regard to food security. The rate among African children has been steadily rising since 1985 and currently stands at 40 %. In order to ensure that children undergo normal physical and mental development, widespread intervention programs must be initiated immediately.

In nine African countries, a multisectoral design program was implemented over a period of 3 years (Remans et al. 2011). The program involved a total of 1,100 children from 2,600 households. The above-mentioned measures were carried out with the result that the stunting rate had diminished by 43 % after 3 years. These children now have a much better chance of developing normally even if food should become scare once again.

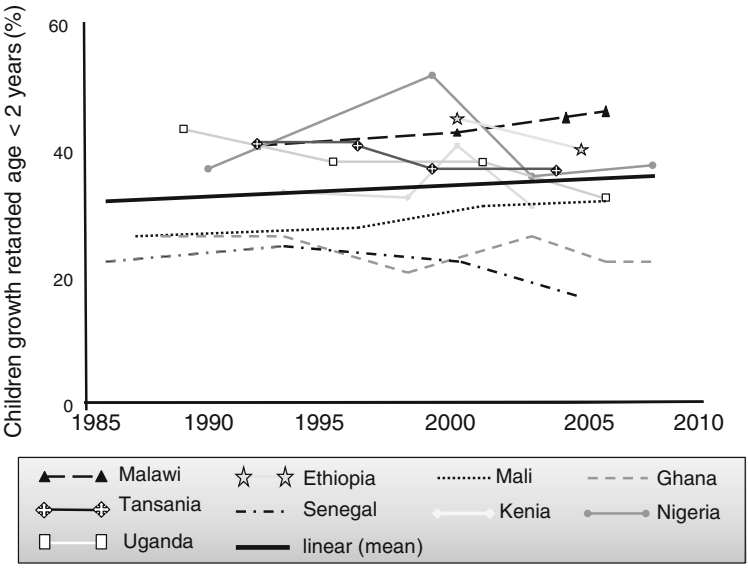

Fig. 7.3 Stunting rate (in %) among children under the age of two in different African countries from 1985 to 2008. The graph shows a clear upward trend (Remans et al. 2011)

Modern Biotechnology

The techniques which have been made possible by modern agro-biotechnology, as well as those which are still in the pipeline, can help to combat hidden hunger, provided they do not rest on the traditional quantity-based view of nutrition. Efforts to produce seeds which require less water and can withstand heat better are without a doubt essential contributions to improving agricultural production, especially since they attempt to work around the climatic changes which are currently taking place, and have already led to improvements in areas affected by water scarcity. However, it still remains to be seen how rising income levels among farmers will ultimately play a part in combatting hidden hunger.

Genetically Modified Food

Rice is one of the most heavily consumed staple foods. In addition to iron and zinc, it also contains vitamin E, folic acid, and pro-vitamin A, albeit in a biologically suboptimal distribution. The concentration of these vitamins in the grain is very low, whereas they are present in much larger quantities in the green leaves of the plant. Thus,they help to shield the plant from oxygen and the damaging effects of UV rays from the sun (which both produce free radicals). However, in the

endosperm, the edible grain of the plant, pro-vitamin A is missing entirely since it can be neither produced nor stored there. Apparently, it is not needed by the grain. By means of genetic modification, the expression of two enzymes, phytoene synthase and a carotene desaturase, is induced, producing lycopene, the red pigment found in tomatoes. Golden rice, however, is yellow due to the fact that it does, in fact, store pro-vitamin A. The reason for this is that the metabolic process for creating pro-vitamin A in the rice plant does not only take place in the leaves (Sachub et al. 2005). The expression of the available enzymes is too low under natural conditions in order to create sufficient amounts of pro-vitamin A, since it is apparently not required by the plant.

The situation is quite a different one regarding carrots, which are well-known as being one of the best sources of pro-vitamin A. Pro-vitamin A is hardly necessary as an antioxidant in this case since carrots grow under the soil and are hardly in contact with UV light. Nevertheless, a mutation which took place in the sixteenth century (either in Ireland or the Netherlands) led to the production of β-carotene. So what happens to the pro-vitamin, which the carrot apparently does not need? It is packed up into small 'garbage bags' made of cellulose. Since the human digestive system cannot open these bags, it can hardly absorb any of the pro-vitamin A from raw carrots. Golden rice is an important and sustainable source of vitamin A, particularly in poor countries. New varieties have significantly higher concentrations than the first-generation varieties and can play a vital role in reducing malnutrition, especially because they possess a high level of bioavailability. In addition, the production of vitamin A from pro-vitamin A is more effective than when pro-vitamin A is taken from other sources (Tang et al. 2009).

It is, however, not the only food crop which has been genetically modified nor should it be the only one in order to provide essential micronutrients to more people (Bouis et al. 2003). Attempts are currently being undertaken to modify the essential fat content and the concentration of vital amino acids, which are either lacking or are contained in only small amounts in oilseed, such as methionine.

One of the most controversial questions in this context is how the poor will benefit from this development. This issue touches upon the cultivation and dietary implications for women and children, as well as the fact that the natural genetic code is being altered. If one weighs the cost of modifying the genetic code against the benefits, then Qaim and his colleagues (Stein et al. 2006) estimate that in India alone, where 71,500 children die annually due to vitamin A deficiency, between 5,500 (conservative estimate) and 39,700 children (optimistic estimate) can be saved with second-generation golden rice (Stein et al. 2006). With regard to improving food security, in particular for the poor, this can certainly be achieved for vitamin A provided that the costs of procuring and cultivating golden rice crops do not vary from those of the traditional varieties. It is of no benefit to small-scale farmers whatsoever if the diet diversity of their families is restricted due to eating more expensive rice. Hence, the vitamin A deficiency would be effectively fought at the expense of preserving other deficiencies.

In 2008, GM cereals were grown on 300 million acres in 25 countries, 15 of which are developing countries (Fedoroff et al. 2010). When it comes to hidden

hunger, genetic modification must also be discussed as a viable option. Syngenta, a British-based seed manufacturer which owns the rights to golden rice, wants to distribute the rice to subsistence farmers in Africa at no additional cost, yet it intends to maintain ownership of all commercial rights to the plant. The International Rice Research Institute wants to introduce golden rice to Asia by the end of 2012.

As long as there are no real alternative sources of vitamin A available, golden rice and other similar agro-biotechnological innovations are big steps toward eliminating micronutrient deficiencies, such as vitamin A. If the price of red palm oil were to be kept more stable, and if the oil were available to more of the population, then it would be a much better and cheaper source. However, as long as we are prepared to burn this nutritionally valuable oil as fuel, we must be prepared to fall back on golden rice and to discuss the value of other genetically modified foods.

Considering the fact that golden rice took more than 15 years to come to market, GM foods are indeed an option for combatting hidden hunger, yet they are hardly a once-and-for-all solution to the problem.

Unfortunately, the object of GM is first and foremost to increase the quantity, not the quality of crops. The cultivation of insect and herbicide resistant varieties is at the forefront of research. Although GM varieties of cereals can close the gap left by crops which require a lot of water or are destroyed by blight, this ultimately solves only part of the problem of chronic malnutrition.

Biofortification

The aim of biofortification is to increase the micronutrient density of staple foods through cultivation in order to improve nutrition. By carefully selecting varieties containing a higher micronutrient density, it should be possible to raise more nutrient-rich crops in poorer regions, as well. There are varieties of rice, for instance, which contain particularly high concentrations of bioavailable iron (Haas et al. 2005). The micronutrients which have been targeted to be enhanced in staple foods by means of biofortification are pro-vitamin A in cassava, corn and sweet potatoes, and iron and zinc in beans, rice and wheat (see Table 7.5).

When looking at Table 7.5, to which certainly other foods can be added in the meanwhile or are in the pipeline at large corporate laboratories, it is necessary to differentiate between two important aspects: modifications which are designed for rich nations and to increase prevention and longevity and those which are specifically designed to combat hidden hunger. The former involves modifying the fat content to create healthy fatty acids (e.g., oleic acid, omega-3 fatty acids, gamma-linolenic acid), which promise to protect against vascular diseases and dementia, as well as to promote brain development during childhood. To promise the people living in poor countries that they will protect their health by consuming healthier types of oil, which have no additional health value aside from the fatty acids, is not

Table 7.5 Examples of enriched food products (Johns and Eyzaguirre 2006)

Food	Nutrient	Method
Corn	Lysine, tryptophan pro-vitamin A phytate reduction	Cultivation
Potatoes	Protein methionine	GMO
Rice	Protein pro-vitamin A iron	GMO GMO cultivation/GMO
Soybeans	Omega-3 fatty acids methionine vitamin E	GMO GMO GMO
Sunflowers	Oleic acid docosapentaenoic acid	Cultivation/GMO GMO
Sweet potatoes	Pro-vitamin A	Cultivation
Tomatoes	Gamma-linolenic acid folic acid lycopene pro-vitamin A flavonoids	GMO

a lucrative proposition since most people living in these countries can hardly afford to buy them. Once again we have the situation in which a food product is manufactured in a country with widespread nutritional problems for the export market. The biofortification of vitamin A, iron or zinc, on the other hand, is especially beneficial to the poor rural population, yet it largely depends upon the price. In 100 g of sweet potatoes, there are approximately 12–14 g of pro-vitamin A, in addition to minimal amounts of zinc and iron. 100 g of sweet potatoes are thus enough to meet the recommended daily allowance of vitamin A, whereby less than 100 g would suffice to eliminate a deficit.

According to Howard Bouis, the founder of the HarvestPlus program which focuses on biofortification, $80 million would be enough to provide vitamin A supplements to 80 million Asian children over a 2-year period, or to supply a third of the population of South Asia with iron over 2 years, as well. The same amount of money would also be enough to enrich staple foods with vital micronutrients by means of biofortification for the entire world population (Bouis et al. 2003).

The loss of diet diversity due to poverty and ignorance is causing nutritional deficits, which lead to health disorders in both rich and poor countries alike. While primarily mothers and their children are affected by malnutrition and its adverse health effects in poor countries, the one-sided diets of many people living in rich countries is causing a worldwide rise in obesity, diabetes, and heart disease. Nutritionally enhanced food products (e.g., iodine, iron, folic acid, and vitamin D) do help to reduce dietary gaps in industrialized nations. However, they cannot

replace a healthy diet which provides all of the essential micronutrients in adequate amounts. The same applies to poor countries, even if the elimination of the well known and very serious deficiencies by means of enhanced food is certainly more effective.

Conclusion

The concept of fortifying food products, regardless of the technique, focuses first of all on benefitting individuals whose diets are made up primarily of staple foods (i.e., cereals). This is certainly the correct approach, however it does not account for the fact that a number of other micronutrients are often lacking in addition to those missing nutrients which are added to enhanced food crops and which account for numerous disorders, such as anemia, night blindness, and diarrhea. However, it is undoubtedly an important approach for lowering the child and maternal mortality rates and can perhaps also help to increase productivity. Despite these efforts, it remains uncertain whether or not the passengers will remain on board the hunger carousel. If the assessment of a deficiency is wholly dependent on the appearance of clinical symptoms, then the treatment of such symptoms must not overshadow other underlying causes of illnesses and developmental disorders. To do so would be to merely shift hidden hunger to another group of micronutrients.

In addition, focusing on fortified foodstuffs as a solution to the problem can result in other vital factors, such as the importance of a proper diet, micronutrient density and diet diversity are left by the wayside, both on a local level (e.g., subsistence farmers who believe that fortified foods full his and his family's nutritional requirements, as well as at the local markets) and in domestic food markets. A fact which must also be remembered (and is often overlooked) is that the occurrence of a particular deficiency, whether vitamin A or iron or any other, is an indicator that those foods which contain the respective micronutrient in larger amounts are not being eaten regularly. Thus, all other micronutrients which these foods contain rich amounts of are also lacking. As important as the various techniques for fortifying food with specific micronutrients may be, this can also lead to a new form of hidden hunger when nutrition is not viewed from a holistic point of view.

Effectiveness of the Measures

Availability

In light of the requirements of food security for less-developed and more highly developed countries, various methods were compared and the promises of the agricultural industry critically examined (Dibden et al. 2011).

For instance, is domestic production sufficient or do foods need to be imported to meet the demand? Is production sustainable enough in light of climate change

and the water supply? Does the distribution system also accompany rural inhabitants and the poor?

The Promise of Agro-Biotechnology

Agro-biotechnology has announced the dawn of a Green Revolution with

- higher crop yields,
- cereals which are better adapted to their environment,
- less use of fertilizer.

Critique

- To date, only herbicide and pesticide-resistant varieties are available.
- Higher crop yields and better adaptability to dry spells and heat still remain only promises.
- More resistant varieties of weeds grow in large numbers following reductions in the use of chemicals.
- Both biodiversity as a whole and indigenous plant species are lost.

Access

An important issue is whether or not the groups which depend on the food in question can afford to purchase it. Can the minimum dietary requirement of 2,100 kcal/day, which is needed to enjoy an active and productive lifestyle, be secured?

The Promise of Agro-Biotechnology

- Higher yields lead to lower prices.

Critique

- Inequalities are ignored.
- Corporate control raises the seed prices.
- The seeds cannot be produced by the farmers themselves.
- Small-scale farmers have no access to the necessary technology.

Nutritiousness

Does agricultural production provide for a healthy and balanced diet according to the various nutritional requirements, as well as ensure diet diversity at all times? Are the foods processed and stored in a reliable manner?

The Promise of Agro-Biotechnology

- Fortified cereals, e.g., golden rice, are designed to meet the dietary needs of people in developing countries.

Critique

- There have so far been no apparent nutritional benefits.

- Both the need for a balanced diet, as well as the socioeconomic barriers which the poor face in achieving a better diet are ignored.

That critique more or less sums up the situation regarding the silver-tongued promises made by the agricultural industry, which will not solve the problem of hidden hunger anytime soon. So what happens next?

Sustainable Dietary Strategies for the Future

The Bretton Woods Agreement, which established the International Monetary Fund (IMF), is one of the principal underlying causes for today's hunger crises. The agreement set up regulatory mechanisms aimed at protecting the agricultural interests, and hence the profits of the founding nations. Developing countries which wanted to join the World Trade Organization (WTO) had to submit to structural stipulations set up by the organization. The guiding principle behind this, which was the brainchild of the World Bank, was that countries with high foreign debts could raise income through free trade in order to pay them off.

The structural stipulations included more specifically:

- the stopping of land reforms (e.g., Indonesia),
- no government regulation of land distribution,
- an increase in the utilization of agricultural technology,
- the ceasing of government farming subsidies,
- the bolstering of livestock breeding for the export market,
- the bolstering of fodder crops for the export market,
- the bolstering of other export crops, such as flowers and exotic fruits.

Regarding the effects of these structural stipulations, the sociologist and Right Livelihood Award laureate (2009) Walden Bello is of the opinion that the holdings of small-scale farmers were more thoroughly ravaged by these measures than by any other force, social, or otherwise (Bello 2009).

The end result is that small-scale farmers in developing countries produce for export markets exclusively, in other words neither to feed their families nor for sale at local markets. The losers of this deal are the small-scale farmers and their families, as well as the poor who are dependent on locally grown produce.

The so-called 'liberalizing' of the market brings profit to the rich countries and more poverty to the poor ones. We can hardly talk of globalization as a market-place in which people from around trade and are treated fairly, at least not as long as those who are too weak to assert themselves or to compete are left along the wayside.

In the end, developing countries' foreign debts have only increased and, as a result, so too has the number of poor and undernourished persons. The neoliberal concept of free markets for developing nations to help them increase productivity and pay off their debts is an inhumane idea. Inhumane because it rests completely on cold, hard economic principles, and ignores the circumstances under which people had lived for a very long time.

The liberalizing of trade bypasses the agricultural infrastructure and markets of developing economies. 90 % of all farms comprise less than 2 ha of land. Among these are 35 million small farms in Africa and 200 million rice farms in Asia (McIntyre 2009). These farms would be enough to produce not only enough staple foods, but also fruits and vegetables for the farmers' own needs and, ideally, for the local markets. Due to the forced low import duties and large quantities of subsidized imported foods (primarily cereals), small-scale farmers stand no chance of feeding themselves or of earning money with produce to help secure the family's financial situation. Our endeavors to combat the problem are nothing but a compensation for governments' errant policies guided in the manner of Don Quixote by our own ignorance.

The traditional small farmer is only able to provide for himself and his family by allocating a portion of the crops for the family's needs and by selling the rest of the produce in order to buy seed and groceries. This presupposes the fact that the farmer has both the land and able-bodied family members who can contribute to crop production. If this is not the case, for instance when children die or are physically weakened due to malnutrition, then the farmer finds himself trapped in the vicious circle of hunger. Even a well-intentioned grain donation is not of much help in such a situation.

The production of export crops as stipulated by the structural framework of the WTO has also forced small-scale farmers to gear production toward this market with all of its implications: The goods must be fresh, they must be delivered, they are subject to strict regulations (best before dates, EU norms etc.) and they are also subject to unforeseeable price fluctuations on the markets. Regardless of these stipulations, the farmers do not have enough land to produce for the export market and, if they are fortunate enough to make a profit, still produce for their own families. Thus, the foundation of food security is missing and it should be no surprise that 75 % of the poor live in rural areas. Of these, according to a report by the UN, 50 % are small-scale farmers, 20 % are landless farmers and 10 % are shepherds. The fact that nearly half of the world's population makes a living from agriculture becomes alarming when the possibilities to provide for oneself and one's family through agricultural production are becoming less and less. In comparison, roughly 4 % of the population in Germany (530,000 full-time jobs) and 5 % of the European population are employed in the agricultural sector (IAASTD 2008).

Two very different models stand in opposition to one another and their antagonism only worsens the plight of small-scale farmers: on the one hand a high-tech and highly productive agricultural industry in developed economies and small-scale and much less productive farms. Only 2 % of the 1.3 billion small-scale farmers worldwide own a tractor, 20 % employ the use of animals, while the other 80 % must do all the work by hand. This requires able-bodied women and children. Depending on the region, up to 70 % of farms are run entirely by women. When it comes to the world's hungry population, it is primarily about these farmers, male and female. They should at least be allowed to have the means to feed their families and pay for health care and education. Then the next generation

of rural farmers can experience the plus side of globalization and not only be left with the short end of the stick.

Subsistence Farming

Subsistence farming is a type of agricultural production which primarily serves to fulfill the dietary requirements of the producers and is independent of the national and international food markets. Farmers and their families should therefore be shielded largely from price fluctuations and be able to secure enough food and quality of life for themselves. This may sound somewhat utopian and unrealistic, however it is the only truly sustainable way for many people to maintain a diet and survive.

The majority of hungry and undernourished persons live off the land. They are small-scale farmers, who can hardly make a profit with their tiny plots of land. Hence, they and their families have to live off their own produce. Yet this is by no means a given and there are a few essential conditions which must be met:

- Subsistence farmers need to fulfill their families' dietary needs, both in terms of quantity and quality. What diet diversity means specifically must be defined for a particular region in terms of quality and quantity based on the (traditional) food products available.
- Subsistence farmers need their own, clearly defined plot, which is suitable to the production of various crops (depending on the climate and soil).
- The primary goal must be to adapt production to the surrounding conditions in order to optimize yields, both from the point of view of quantity and quality, not to increase crop yields at all costs.
- Grasslands as grazing grounds for livestock would be a vital factor in improving nutrition.

There are more than enough models which describe how subsistence farming should be established. Many plans have already been implemented. One of the pioneers is Via Campesina, an organization which was founded in Indonesia in 1993 to represent the interests of small-scale farmers. Via Campesina introduced and promotes the concept of 'food sovereignty', which is a policy framework for food security for peasant farmers and other groups. Not only does food sovereignty stipulate the right of all individuals to an adequate and nutritious diet, but it also the right of each person and nation to grow and harvest crops. This means that every nation on earth and thus every farmer must be literally given the freedom to produce their own food.

Some tenets which are directed at national governments, as well as international trade organizations (Engel 2002) are:

- that the production of healthy, nutritious foodstuffs, which takes into account the natural and social surroundings, must be given top priority regarding government subsidies, that food is produced primarily for the family, and local, and domestic markets,

- that farmers are paid fairly for their produce,
- that surpluses are avoided by means of regulation,
- that every country must have a means of protecting itself against cheap imports so that increases in domestic staple food prices do not hurt local farmers,
- that every kind of export subsidy and measure which lowers export prices to below production costs is forbidden.

Attempts to transform peasant farms into industrial enterprises and incorporate them into the world agricultural industry have in grand style with devastating consequences—devastating because of the stagnation and general mood of resignation which they have triggered. This is not least of all visible from the fact that the target of reducing poverty and halving the number of hungry and undernourished persons by 2015 will not be achieved, but rather the reverse trend can be observed.

The reason is not that peasant farmers in many developing countries were unable or unwilling to increase their productivity. Rather the explanation lies in the fact that peasant farmers are confronted with national and international policies which oppose their interests and foil their ideas, such as land grabbing, price dumping and biofuel production. There is a certain mystique surrounding the 'pastoral lifestyle' which we are encouraged to believe yet which in no way reflects the hard reality of life and work for the peasants we can only see through a glass darkly. Poverty and hunger, coupled with helplessness, put the brakes on every initiative to change the status quo. We can hardly blame the people living in regions rife with malnutrition when they sit and stare at the ground with their hands folded because there is often not much else that they can do.

While in developing countries the potential to produce food which satisfies basic dietary requirements in accordance with the concept of food sovereignty does exist and could indeed contribute to reducing poverty and hunger, the globalized agricultural industry is geared toward making profits and not toward bolstering food security.

Unlike the agricultural industry, nutrition science, which concerns itself with many of the issues at hand, does not have an international lobby and therefore does not have a real voice. It would be an absurdity when the majority of nutrition scientists around the world, who work on developing healthier forms of nourishment by means of phytochemicals, nutrigenomics, or modified fruits and vegetables, did not address the issue of food security and how it can be achieved. Of what benefit is it to an Ethiopian farmer, who can expect to live roughly 46 years, when oils enriched with omega-3 fatty acids, which are believed on the basis of insufficient data to prolong life expectancy by preventing arteriosclerosis, are offered at the local market? It is more than ironic that such products are sponsored by the EU and produced on land where vegetable crops or indigenous oilseed could have been cultivated. Barring a very few exceptions, the agricultural, nutrition science, and health care sector have remained completely isolated from each other and have not engaged in collaboration with regard to research and knowledge transfer to this very day.

The primarily profit-oriented agricultural sector has so far devoted little resources to the issue of quality, i.e., which vital micronutrients are contained in the different crops which it produces. The reasons for this are politics, the lure of higher profits by increasing production and, quite simply, ignorance. When calls are made once again to move in the direction of higher crop yields to feed the growing population in the coming years, heeding the calls means taking two steps back. When one views the results of the Green Revolution, which brought about an explosion in rice and wheat harvests, from the point of view of those who depend on these staple crops, then one hardly notices any real progress. As mentioned previously, rice and wheat contain protein plus a very few essential micronutrients. The fact that within a few years after the first shots of the Green Revolution were fired, the calories available in Asia increased in some regions by more than 25 %, led many to celebrate an apparent victory in the war on hidden hunger. Unfortunately, what many people overlooked is the fact that the consumption of more calories alone does indeed supply more energy, but it is no replacement for high-quality, nutritious food.

The advancement of subsistence farming means giving peasants the possibility to live, look forward to and shape their future with dignity.

The Future of Food Security

In the wake of the Green Revolution with the introduction of chemical and mechanical technologies, the amount of calories available to each person has increased significantly (see Table 7.6).

At the same time, the Green Revolution helped to give rise to a powerful agricultural industry, which still generates revenue from a valuable 'raw material'—food, primarily cereals. The food business is not geared toward the end users of the products, but rather toward the world markets and profit. The world's population is continuing to rise and is creating for itself the challenge of feeding further billions of people who will join its ranks, particularly in Asia. By 2050, the number of calories per capita will sink to below 2,200 kcal in some countries if nothing decisive is done. This does not even take into account the impact of climate change, biofuels and the forces connected to the hunger carousel.

Table 7.6 Availability of dietary energy (WHO 2010a, b)

	1970	2000
Global average	2,410	2,800
Industrialized countries	3,130	3,230
Southeast Asia	2,010	2,920
Africa	2,100	2,190

By concentrating on calories and not on quality, the Green Revolution succeeded in reducing the number of undernourished people worldwide, yet it ignored the problem of hidden hunger and probably even worsened it. The situation is reminiscent of the euphoria which was rife when biofuels were first introduced. There were promises of unlimited resources, jobs for the poor and a reduction in hunger and poverty.

Despite all of its apparent advantages, the Green Revolution also led to a move toward the new monocultures in Asia since these were believed to be more lucrative. Thus, crop rotation was abandoned (Graham et al. 2007). In India, the Green Revolution has led to a 25 % increase in crop yields, yet the situation regarding child mortality and malnutrition has remained largely unchanged (Bamji 2007). In light of all that has been said about the problem of hidden hunger, this can hardly be surprising.

There have been no such increases in production in Africa. The reason for this is two-fold. During the 1960s, many African countries became independent, making it necessary to reorganize their farming industries. More serious, however, was the fact that many traditional food crops in many regions throughout the continent, such as corn, cassava and millet, did not have a lobby to promote the development of related, yet higher-yield varieties. Sub-Saharan Africa is the only region in the world where the number of people living in poverty has increased by more than 50 % (Kates and Dasgupta 2007).

The development of high-yield varieties began in 1944 as the American agricultural scientist Norman Borlaug, the father of the Green Revolution, initiated a project to increase wheat production with funding from the Rockefeller Foundation. In 1965, these varieties were introduced to Pakistan and India, resulting in a doubling of wheat production from 4.6 to 8.4 million tons within a 5-year period. This impressive development in yields must not detract from the fact that India is still among the countries with the highest under-five mortality rate, as well as the highest number of malnourished children. The simple formula

$$\text{worldwide production} = \text{land} \times \text{yield}$$

still holds true today. The motivating factor behind higher crop yields is primarily profit and has less to do with concerns about feeding the population. The trade regulations set up by the USA and the EU in order to preserve growth-oriented developments will not be elaborated upon at this juncture. However, in a nutshell, it can be said that these measures have ultimately led to the Green Revolution being relativized in many countries where poverty has increased.

The progression of the Green Revolution is, on the one hand, the foundation for a booming agricultural industry, as well as a source of quick profit through speculation and, on the other hand, it has apparently contributed to reducing world hunger. At the same time, however, crop yields after 1970 have triggered numerous hunger crises, for instance in Indonesia in 2003 and globally in 2008 due to higher rice and wheat prices. These price hikes do, however, have a profound impact on what people eat and, thus, how they develop, in particular children

under the age of five. With every percentage point that food prices increase by, another 1,000 children under the age of five die.

The Green Revolution has so far ignored one essential aspect—people's true dietary needs. A dialog with nutrition scientists concerning the quality of food products as a basic requirement for human development has hitherto not taken place. The impetus for such an exchange has also been largely absent in the nutrition science camp. Researchers have been much too enthralled by molecular methodology as to devote their attention to such mundane issue as food security. As a result, a quantity-oriented gauge was established by the agricultural industry: the daily amount of calories required in order to ensure a person's normal development and performance.

2,200 kcal is the minimum amount required by a person to survive. In purely mathematical terms, 2,800 kcal are available to each person today. Without an increase in crop production in the future, only 2,200 kcal will be available to each person in 2050. Normal Bolaug took up the issue of a quantity-based view of nutrition in a *Science* editorial (2007) entitled "Feeding a Hungry World":

> For the foreseeable future, plants—especially the cereals—will continue to supply much of our increased food demand, both for direct human consumption and as livestock feed to satisfy the rapidly growing demand for meat in the newly industrializing countries. The demand for cereals will probably grow by 50 % over the next 20 years, and even larger harvests will be needed if more grain is diverted to produce biofuels. (Borlaug 2007)

It has been amply demonstrated that precisely this approach is merely a partial solution to the problem, yet one which is still promoted. Nutrition and diet diversity go hand-in-hand within the context of food security. Then, and only then, can a safe assessment of who has enough to eat and who does not be carried out. A focused evaluation of locally available foods with regard to their micronutrient density would be much more effective than numerous other measures in helping to optimize the diets of both rural and urban populations.

Figure 7.4 recapitulates the problems described at length earlier. The extremely poor (i.e., those earning <$1.25/day), as well as the very poor (<$2.00/day) have no chance to defeat hidden hunger. The former draw at least 90 % of their diets from rice (or other cereals), while the latter draw 85 % from these sources.

Table 7.7 illustrates the difficulty involved in even remotely fulfilling the RNI for certain micronutrients when income levels decrease, a situation which is particularly critical for pregnant women.

Depending on the variety, beans can supply up to 50 % of the RNI for folic acid, iron, and zinc. There is a wide plethora of local varieties.

Although the values may vary depending on the region, Table 7.8 shows one solid fact. The composition of an adequate diet requires knowledge of nutrition, arising either from tradition and empirical knowledge or from counseling. However, micronutrient deficiencies can only be sustainably eliminated once other foodstuffs, which are currently only available to those with higher-incomes (see Fig. 7.4) are available to all. It is precisely these food products which can close the gaps created by the missing micronutrients, which, in turn, are representative of

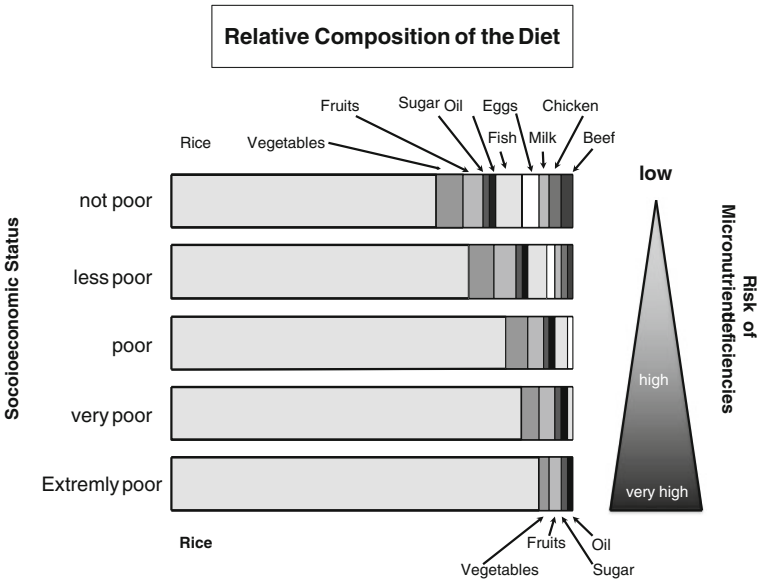

Fig. 7.4 Distribution of the various food groups in relation to income and the risk of malnutrition. (Semba et al. 2011)

Table 7.7 RNI for pregnant women

First trimester	Protein	Vitamin A	Iron	Folic acid	Zinc	Calcium	Vitamin E
Recommended amount	60 g	800 µg	30 mg	600 µg	11 mg	1,000 mg	75 mg
% RNI per 100 g food							
Rice	0	0	1	2	4	0	0
Cassava (root)	2	0	1	5	3	2	0
Millet	6	0	2	14	8	0	0
Meat (chicken)	37	0	3	1	14	1	3
Mung beans	40	2	22	104	24	13	7
Soybeans (green)	18	2	13	28	13	4	78
Cabbage	3	1	1	10	2	4	2
Tomatoes	2	18	1	3	2	1	7
Green leafy vegetables	6	106	5	30–77	11	18	58
Moringa leaves	7	146	11	49	5	10	65
Amaranth	9	160	6	31	6	32	17
Jute leaves	10	198	12	21	0	36	36
Solanaceae (nightshade)	8	101	13	10	9	21	28
African leafy vegetables	8	193	6	27	3	54	101

Table 7.8 Available food types containing micronutrients in developing countries and their typical relationships to hidden hunger

Micronutrient	Food type	Quantity RE/100 g conversion rate 1:6
Vitamin A	Beef liver	8,000
	Chicken liver	4,000
	Eggs (yolk)	200
Pro-vitamin A	Sweet potatoes	1,000
	Carrots	850
	Bell pepper	250
	Squash	200
	Mango	200
	Melon	150
	Papaya	100
	Green leafy vegetables	300
		mg/100 g
Iron (animal derived)	Poultry	7
	Beef liver	6
	Beef	4
	Mutton	3
Iron (plant derived)	Millet	1–20
	Soybeans	5
	Buckwheat flour	4–15
	Beans	2–8
Zinc	Meat/meat products	2–7
	Quinoa	5
	Buckwheat flour	3
	Barley	2

average values modified according to Johns and Eyzaguirre 2006

hidden hunger and which are indicative of a range of dietary deficits. Taking into account the 'special' foods which are distinguished by the amounts of vitamin A, iron, and zinc which they contain, it is quite clear that a combination of these, together with the staple foods, are sufficient to guarantee a person an adequate diet.

Local nutrition campaigns can provide counseling based upon a combination of different food types, thus helping to improve diet diversity. To do so requires knowledge of the nutritional make-up of the different food types, as well as the

taking into account of food prices, including those of fortified foods. The result would be a sensible dietary mix with the maximum micronutrient density.

Unlike the situation in rich countries, fruits and vegetables have a more prominent role in the diets of hungry people in developing countries and are a means of minimizing the effects of hidden hunger. There is a highly significant link between the availability of vegetables and both wasting and mortality among under-five year olds (Keatinge et al. 2011). Countries in which vegetables are the scarcest, such as Niger, Mali, Tanzania (<120 g/pers), have a much higher child mortality rate (230/1,000) than those with more than 150 g per person. Yet availability does not necessarily mean that the people have access to the respective foods, as Fig. 7.4 clearly illustrates. The availability of certain foods could be utilized to eliminate micronutrient deficiencies in combination with nutritionally fortified foods and supplements, both on a short-term as well as a long-term basis.

In other words, it is a question of diet diversity and micronutrient density when it comes to fighting hidden hunger and its effects, not simply 'counting calories'. This can be based upon a pre-defined selection of foods providing a mathematical model in the spirit of food security. This is the only way to develop long-term strategies, which are circumspect and take into account all influencing factors and can also be implemented by the victims themselves.

What is needed is a second Green Revolution with the four pillars of food security as its goal and not simply higher crop yields. The problem of hidden hunger and child mortality can be solved step by step. Nutrition scientists must also adopt a new paradigm and reconsider what their real mission is. It is not enough to vainly observe the building blocks of nutrition through a microscope and to rattle on about the wonders of GM foods.

Hidden hunger lies at the very heart of nutrition science, yet it has so far been neglected. We concern ourselves with hypothetical contaminants in food products or the potential risks of smoking whilst taking vitamin pills. It has been calculated that 0.018 smokers in 1,000 might harm their health through the use of vitamin pills. This statistic pales in comparison to the 250 children in 1,000 in South East Asia who die from a lack of vitamin A, iron and zinc before reaching the age of five. Malnutrition is first and foremost a result of poverty. Any analysis of treatment of malnutrition must take this fact into consideration.

The fact that poverty is on the rise in industrialized countries and that children are the primary victims of this development is an issue, which is often overlooked. The fact that being poor means having a poor diet and little diet diversity means that children who live in the land of plenty also suffer from malnutrition—a fact that only seems to interest a very few people. In any case, there have been no studies to date to monitor the diets of children whose parents receive welfare benefits, particularly single parents.

Both the quality and the quantity of food in one's diet are both determining factors when it comes to physical and mental development. Humans' dependency on essential micronutrients and our inability to specifically target these in our diet has turned us de facto into omnivores. Climate change and increasing aridness most probably altered the lives of our ancestors three to four million years ago in

the forests of East Africa. These changes made it necessary to search for new means of sustenance. They apparently learned to fear the hunger they felt more and more often.

Their tastes led them to go from being strictly frugivores (eaters of sweets) to consumers of other foods including meat. This shift profoundly influenced humans' evolution. The brain developed in accordance with the micronutrients found in these new foods (e.g. omega-3 fatty acids found in fish) as did the body (e.g. protein found in meat). They became hunters in order to secure a supply of meat during their wanderings over many generations. Apparently, this lifestyle was beneficial to our ancestors and they prospered and developed, yet there were certain to have been periods of food scarcity. Such a period sparked a development which began only 10,000 years ago. Early humans learned to produce food and store it and thus prevent such agonizing periods of food scarcity. Due to their early development, humans laid the groundwork for the modern-day dilemma of hidden hunger.

What appears to be an advantage actually conceals a dilemma for the human race. When one or more vital micronutrients are missing from our diets, our development is stunted. We enter into the vicious circle of hunger without perhaps even realizing it.

The 55 most important aid organizations, in cooperation with representatives of the WHO, the World Bank and other government organizations, have calculated the costs of eradicating worldwide hunger on the basis of scientifically sound intervention studies (SUN 2010). Unlike the Copenhagen Consensus, productivity was not the most important aspect, but rather empirical data collected from various measures applied within the context of scientific studies. The recommendations are aimed at children under the age of two since this is the period during which the hunger circle must be broken if the children are to have any prospect of a normal future away from the hunger carousel.

Advancement of Healthy Dietary Practices ($2.9 billion)

- breastfeeding;
- additional feeding of children after 6 months;
- improvements in hygiene including washing one's hands.

Improvements in Vitamin and Mineral Intake ($1.5 billion)

- periodic vitamin A supplements;
- therapeutic administering of zinc in cases of diarrhea;
- micronutrient powder (sprinkles);
- deworming (to reduce the loss of nutrients);
- iron and folic acid supplements for expectant mothers and to treat anemia;
- iodized oil if iodized salt is not available.

Administration of Micronutrients Through Food Enrichment ($1 billion)

- salt iodization;
- iron fortification of staple foods.

Therapeutic Feeding of Malnourished Children with Ready-to-Use Therapeutic Foods/RUTFs ($6.2 billion)

- prevention or treatment of moderate undernourishment;
- treatment of severe undernourishment (and malnourishment) with RUTFs.

Most of these measures are related to improving micronutrient status where it is necessary and, barring the last point, increasing caloric intake. This approach, should it be implemented, is a mid-term solution. In the long run, the poor can only truly be helped by supporting peasant farmers and initiatives for women. Women must not only be able to feed their families, either with home-grown produce or from their personal income, but they must also be put in a position to free themselves from poverty and from the powerful force of the hunger carousel.

Outlook

In conclusion, the ultimate question is "What happens now and what can be done?" I ask myself, as others are also asking themselves, why so little is known about hidden hunger in all its complexity and with all of its adverse effects. What has gone wrong? Naturally, there are well-known reasons for the problem, such as consumer behavior in rich countries and the discount shopping mentality, or the common expectation to have all varieties of food from all over the world throughout the entire year. To do so at this point would be redundant. This has all been said before and nothing has changed. It might be the case, however, that the different facets of the problem have not been explained to consumers in a manner which helps them to understand and connect the dots. In fact, such dialogue has not even been possible between agriculturalists and dieticians.

In a report by Olivier De Schutter, the UN Special Rapporteur on the Right to Food, he writes

> The right to food cannot be reduced to a right not to starve. It is an inclusive right to an adequate diet providing all the nutritional elements an individual requires to live a healthy and active life, and the means to access them. States have a duty to protect the right to an adequate diet, in particular, by regulating the food system, and to fulfil the right to adequate food by proactively strengthening people's access to resources, allowing them to have adequate diets. […] Agrifood companies also have a responsibility to respect the right to adequate food. They must avoid infringing upon this right, and seek to prevent any adverse impact their activities might have on the enjoyment of this right. […]
>
> The world is now paying a high price for having focused almost exclusively on increasing production over the past half-century. Undernutrition remains considerable, largely because agrifood systems have not contributed to the alleviation of rural poverty. […] Like undernutrition, micronutrient deficiency or "hidden hunger" is a violation of a child's right to a standard of living adequate for the child's physical and mental development […]. States, therefore, have a duty to support exclusive breastfeeding for six months and continued breastfeeding, combined with adequate complementary foods, until the second birthday of the child; and to establish food systems that can ensure each individual's access not only to sufficient caloric intake, but also to sufficiently diverse diets, providing the full range of micronutrients required (UN Report, 26 Dec. 2011).

If we took the rights of every individual to an adequate diet as seriously as we take the issue of human rights, and if we proclaimed these as loudly and as often as we rightly do with regard to human rights, then the first big step toward making a change would be taken. That is my wish and my motivation for writing this book.

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