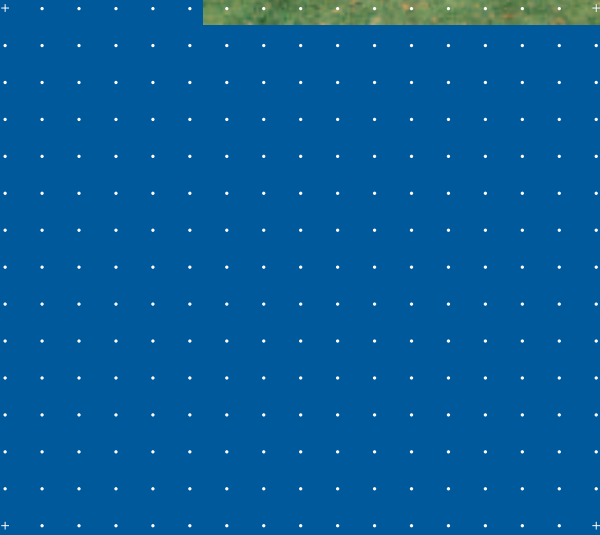


Improving children's nutrition for a healthier, more prosperous future

a **DSM** Service



DSM Nutritional Products

Unlimited. **DSM**

Childhood malnutrition impairs national development

Today's children are our investment for the future! Only healthy, well nourished children can grow and develop properly, and so bring prosperity and well-being to the country they live in.

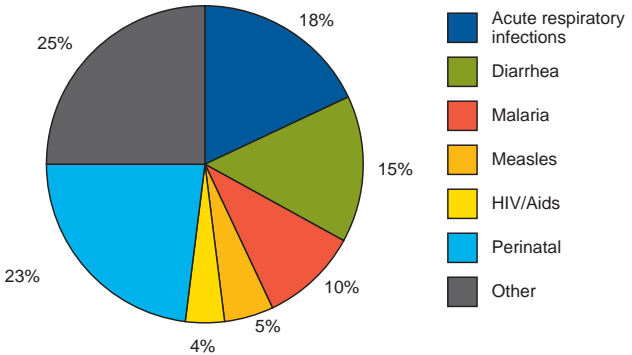
Yet far too many children in today's world are still deprived of basic needs such as clean water, nutritious foods, proper sanitation and health care. Malnutrition has left hundreds of millions of children across the globe stunted, as well as physically and mentally impaired (State of the World's Children 1998, Unicef). Moreover, their immune function is compromised, so that even minor infections can have a fatal outcome. Every year, more than ten

million children under five years of age die from causes that are preventable (Figure 1). At least half of these deaths are linked to malnutrition (SCN; 5th Report of the World Nutrition Situation, 2004). This high mortality is incompatible with acceptable humanitarian standards.

Even children who appear to be eating enough food to sustain adequate growth and development may be malnourished. The diets of many children



Causes of death among under fives 2002



contain suboptimal amounts of vital nutrients such as vitamins and minerals. These deficiencies, although too subtle to be recognized without special tests, can also lower children's ability to learn, and make it harder for them to contribute adequately to their family's income when they become adults.

Specialists at the World Bank have calculated that malnutrition could waste as much as 5% of a nation's gross domestic product (GDP), while solutions to the problem are available at a fraction of the cost. Following an extensive review of the available research on nutrition and productivity, Professor Jere Behrman (*The Economic Rationale for Investing in Nutrition*, 1992) concluded that improving nutrition has direct impacts on school performance and labor productivity, and contributes significantly to the achievement of national development goals.

Childhood malnutrition can be prevented

Malnutrition is a complex condition with multiple, often overlapping causes involving poverty, ignorance, lack of food, hygiene, sanitation and health care, as well as female discrimination. Breastfeeding is the foundation of good nutrition for infants. Inadequate breastfeeding, together with poor hygiene and sanitation, increases an infant's risk of developing diarrhea, which compromises nutrient uptakes, and leads to dehydration. Many infectious diseases impair appetite, although the body's immune response increases nutritional requirements. Childhood malnutrition has also been linked to parent's lack of education, and their ignorance about hygiene and child care.



Malnourished children who manage to survive are at a lifelong disadvantage. Deficiencies of iodine and iron can cause irreversible brain damage and lower IQ significantly. Deficiencies of vitamin A and B complex impair immunity,



increasing the deleterious effects of infectious diseases. Vitamin D deficiency results in impaired bone formation, including rickets. A poor antioxidant status increases the risk for chronic conditions such as diabetes and heart disease in later life.

Throughout the world, governments and international organizations, as well as economic and health specialists are beginning to recognize the importance of good nutrition in childhood for national development. The UN Millennium Development Goals, which all United Nations Member States have pledged to meet by the year 2015, are closely linked to reducing malnutrition in children. Many prominent organizations have formulated specific goals that can only be reached by ensuring that children eat a balanced, micronutrient-rich diet. These goals are:

- To reduce perinatal and under-five mortality to levels seen in the developed world
- To eliminate stunting and wasting
- To eliminate iodine deficiency and goiter
- To eliminate vitamin A deficiency and zinc deficiency
- To reduce the burden of anemia to levels seen in the developed world
- To reduce infectious diseases and diarrhea
- To reduce the spread of HIV, and especially transmission of HIV from mother to child
- To increase survival of children infected with HIV.

An optimal nutritional status during childhood allows children to grow normally, helps to protect them against infectious diseases, and improves learning ability and school performance.

Good nutrition improves resistance to infectious diseases

Children in developing countries are exposed to malaria, cholera, intestinal parasites and tuberculosis. Many are infected with the HIV/AIDS virus. This puts an enormous strain on their health and well-being. Strengthening immunity is one important strategy to help children survive and thrive.

To maintain an effective immune response to infections, it is crucial that children have adequate intakes of energy, protein and essential fatty acids as well as vitamins and minerals. Critical micronutrients to support immunity are vitamins C and B-complex, the fat-soluble vitamins A and E, iron, copper, zinc, selenium and carotenoids, especially beta-carotene.

Clean water is essential to avoid diarrhea and dehydration. Resistance against intestinal pathogens such as rotavirus can be reduced by the introduction of probiotic bacteria. Probiotic bacteria can be added to dairy foods, beverages and cereals. Special freeze dried formulations for incorporation in dry powders and capsules have been developed.

Children with HIV/AIDS need special nutritional support

In many parts of the world, particularly in sub-Saharan Africa, HIV/AIDS has reached epidemic proportions with devastating effects on the population and its economic prospects. In some African countries up to 20% of the population is infected. Despite efforts to contain the disease, HIV/AIDS continues to spread.

Children infected with HIV have increased energy and micronutrient needs related to impaired immune function and metabolic complications of the disease. They are at

increased risk for vitamin A, E and zinc deficiencies, and need particular care and special nutritional support. Increased energy and micronutrient needs of HIV positive children are best met by a balanced, nutrient dense diet. Staple foods enriched with essential vitamins and minerals further are of great value to increase energy and micronutrient intake in infected children (see table for reference).





Good nutrition improves learning and school performance

Hungry children cannot learn! Chronic undernutrition leads to fatigue, lethargy and inability to solve problems. Hungry children lack energy and motivation to learn. Deficiencies of essential vitamins and minerals greatly reduce their attention span.

Research conducted over the past fifty years has clearly shown that nutritious foods supplying adequate levels of energy, protein, essential fatty acids, vitamins, iron, iodine and zinc are essential if children are to reach their full intellectual potential. Several well conducted intervention studies and programs have shown that the nutritional situation of children is greatly improved by the introduction of school feeding programs.

Good nutrition is achievable

Children's diets can best be improved through a combination of four strategies:

- Nutrition education
- Dietary diversification
- Food fortification and
- Micronutrient supplementation.

Food fortification with essential vitamins, minerals and trace elements is an important and well accepted and sustainable strategy to combat micronutrient malnutrition. The technology is simple, efficacious, cost-effective and safe. It does not require consumer participation. Food fortification is globally accepted and sustainable. The food industry is ready to apply food fortification in order to make an important contribution towards the prevention of micronutrient deficiencies and the improvement of public health.





Weaning foods

Weaning food provide the necessary energy, protein, fats and micronutrients needed for growth, which at the age of 6 months can no longer be met by breast milk or a breast milk substitute alone. Weaning foods bridge the nutrient gap between mothers milk and the introduction of solid food between 6 months and 2 years of age.

Weaning foods should be formulated to contain adequate levels of energy, high-quality protein, preferably derived from milk, soybeans or other legumes. The main carbohydrate source should be cereal starch which may be predigested to facilitate digestion and increase palatability. The fat source may be soybean or corn oil, which provide adequate levels of essential fatty acids. Particular attention should be given to the right balance of omega-6 to omega-3 fatty acids. Research has shown that the long-chain omega-3 fatty acids EPA (eicosapentaenoic acid) and DHA (docosahexaenoic acid) are essential for visual acuity and brain development. Whenever possible EPA and DHA should be added to weaning foods, fortified milk and vegetable oils.

Weaning foods should also be adequate with regard to the fat-soluble vitamins (A, D, E, K), vitamin C and B-vitamins, and the minerals calcium, magnesium, iron, copper, zinc and iodine.

Home addition of vitamins and minerals to weaning foods

The nutritional value of weaning foods prepared in the home can be improved by sprinkling a micronutrient mixture on the food just before feeding. Special micronutrient mixes for weaning foods have been developed. The „**FoodLet**” is a soft tablet containing vitamins, iron and zinc that can easily be crushed and sprinkled over an infant’s food to enrich its nutritional value.

Staple food fortification

Many people in developing countries meet up to 90% of their daily energy requirement with basic foods (staple foods), such as bread, maize, rice or tubers. From a nutritional point of view starchy foods are inadequate sources of micronutrients. **Cereal foods** completely lack vitamin A activity, levels of iron and zinc are low, and the bioavailability of trace elements is compromised by high levels of phytic acid.

Cereal milling and processing leads to severe depletion of many essential micronutrients including B-vitamins, vitamin E, iron, zinc and selenium. At the beginning of the 19th century, widespread deficiencies of B-vitamins occurred in communities consuming high cereal based diets (corn meal, white wheat flour, polished rice). The introduction of cereal fortification with vitamins and iron eradicated vitamin deficiencies in Europe, Canada, the United States of America, Latin America, The Philippines, Indonesia and China.

Vegetable oils and fats are also suitable vehicles for fortification. The fat-soluble vitamins A, D3 and E are easily dissolved in vegetable oils and fats and remain stable under normal conditions of processing, storage and household use. Fortified vegetable oils can make an important contribution to children's intakes of

Fortification concepts for staple foods

Food/beverage	Vitamin A, D, E	Vitamin B
Wheat flour	X	
Maize meal	X	
Cereal	X	X
Weaning food	X	X
Vegetable oils	X	
Margarine	X	
Milk & milk powder	X	X
Peanut butter	X	X
Soups, condiments	X	X
Beverages	X	X
Sugar	X	
Salt		



these fat-soluble vitamins. Fortified vegetable oil should be added to weaning foods.

In many tropical countries **sugar** is a major agricultural product consumed by the majority of the population, children and adults alike. Sugar is consumed almost on a daily basis as a sweetener in non-alcoholic beverages, bakery products, cereals and foods prepared at home. Vitamin-A-fortified sugar was first introduced in Guatemala in 1971. Since its introduction, fortified sugar has proven effective in preventing vitamin A deficiency in children and adults, especially pregnant women.

h C	B-Vitamins	Calcium, magnesium	Iron, zinc, selenium	Iodine
	X	X	X	
	X	X	X	
	X	X	X	X
	X	X	X	X
	X			
	X	X	X	X
	X			
	X	X	X	X
	X	X	X	
			X	X

In recent years vitamin A fortification of sugar has been introduced in other countries such as Honduras, Vietnam, Zambia and Nigeria.

School feeding programs

By providing nutritious foods at school, children's ability and motivation to learn can be improved, and students will be more able to face the challenges of the modern world. The efficacy of school feeding to improve learning has been documented from studies in Jamaica, Peru and the United States of America. Successful school lunch programs are also run in South Africa, Morocco and many other countries.

After a long walk from remote areas, children arrive at school exhausted instead of fit and receptive for learning.





A school feeding trial carried out in the Peruvian Andes has shown that children fed breakfast on arrival at school perform better, have longer attention spans and are more active compared to children not getting breakfast at school.

Convinced of the high efficiency of school feeding, the World Food Program (WFP) is supporting a number of school feeding projects around the world. Guidelines on how to develop and implement school feeding programs have been developed.

Today, school feeding is again in the headlines in many western countries because of children's poor nutritional habits. Eating patterns, predominantly based on fast food and soft drinks with little or no fresh fruit, vegetables and dairy foods, can lead to obesity and its consequences such as high blood pressure and diabetes. To combat faulty eating habits and obesity, schools in England have started school lunch programs, and are promoting healthy eating patterns including fruits, vegetables, fortified cereals and milk in schools.

Dietary supplements for children

Ideally, a diet rich in fruits and vegetables with moderate amounts of cereals, dairy foods, eggs and meat can fulfil the daily micronutrient needs of a healthy growing child. Reality, however, shows that children rarely get enough wholesome foods for proper growth and development. Severe vitamin A deficiency and its devastating consequences can be averted by immediate vitamin A supplementation. Many successful programs are ongoing in Africa, Asia and Latin America. Broad experience over the past decades has shown that micronutrient supplementation is particularly efficient for combating vitamin A, vitamin D and iron deficiencies.



Good nutrition is cost effective

Programs aimed at improving children's nutritional status, especially those that ensure adequate intakes of micro-nutrients, dramatically enhance survival, education, productivity and overall health. The economic value of such programs is impressive, and the returns on investment considerably exceed the costs. Nutritional interventions can produce the desired results in a short time, yet have effects that spread over generations. Faced with the widespread problem of micronutrient malnutrition in children and the many low-cost alternatives that are available to eliminate it, it is imperative to start now!

DSM: A partner you can trust

DSM Nutritional Products Ltd. – a world leader in life sciences – is dedicated to improving children's nutrition and health. Through its Nutrition Improvement Program/Unlocking Human Potential, DSM Nutritional Products is supporting micronutrient related activities in developing countries. The mission of the global Nutrition Improvement team is to provide state-of-the-art technical and scientific support to stakeholders active in public health programs aimed at enhancing nutrition, health and well-being for all.

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FAO/WHO Vitamin and mineral requirements of infants, children and adolescents^{*)}

Vitamins	Units/day	Infants	Children	Adolescents
		7-12 months	7-9 years	10-18 years
Vitamin A	RE ¹⁾	400	500	600
Vitamin D	mcg	5	5	5
Vitamin E	TE ²⁾	2.7	7.0	10
Vitamin K	mcg	10	25	55
Vitamin C	mg	30	35	40
Vitamin B1	mg	0.3	0.9	1.2
Vitamin B2	mg	0.4	0.9	1.3
Vitamin B6	mg	0.3	1.0	1.3
Niacin	mg	4	12	16
Vitamin B12	mcg	0.7	1.8	2.4
Folic acid	mcg	80	300	400
Pantothenate	mg	1.8	4	5
Biotin	mcg	6	20	25

Minerals	Units/day	Infants	Children	Adolescents
		7-12 months	7-9 years	10-18 years
Calcium	mg	400	700	1300
Magnesium	mg	54	100	230
Iron ³⁾	mg	9.3	8.9	14-18.8
Zinc ⁴⁾	mg	4.1	5.6	8.6
Selenium	mg	10	21	32
Iodine	mg	90	120	150

^{*)} Extracted from "Vitamin and mineral requirements in human nutrition", second edition, Joint FAO/WHO Expert Consultation Bangkok, Thailand 1998

¹⁾ RE = retinol equivalent: 1 RE = 1 mcg Retinol = 6 mcg beta carotene

²⁾ TE = mg alpha-tocopherol equivalent

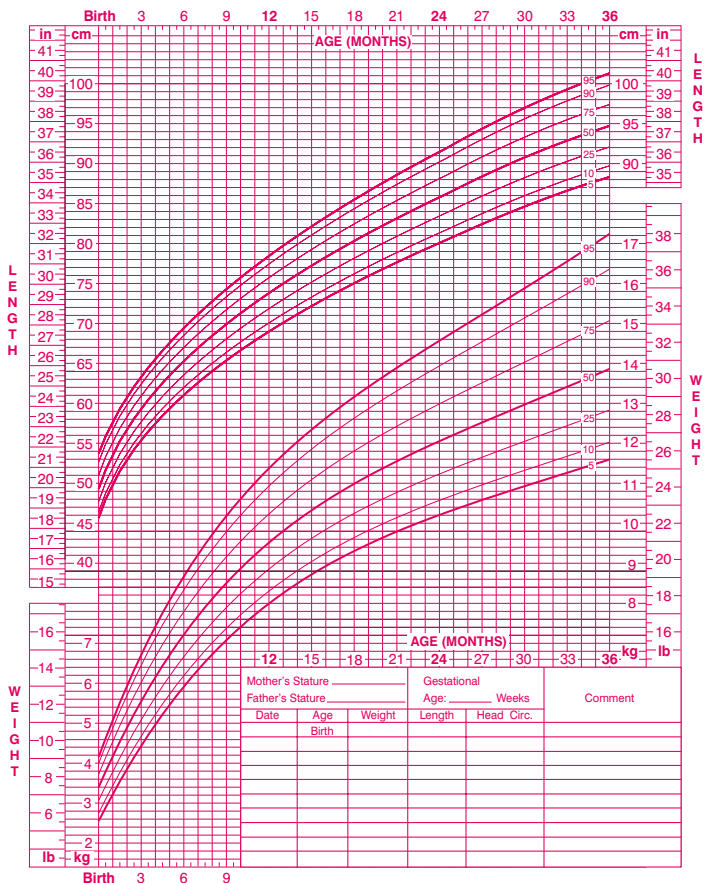
³⁾ In diets of moderate iron bioavailability

⁴⁾ In diets of moderate zinc bioavailability

Growth chart girls

Birth to 36 months: Girls Length-for-age and Weight-for-age percentiles

NAME _____
RECORD # _____



Published May 30, 2000 (modified 4/20/01).
SOURCE: Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2000).
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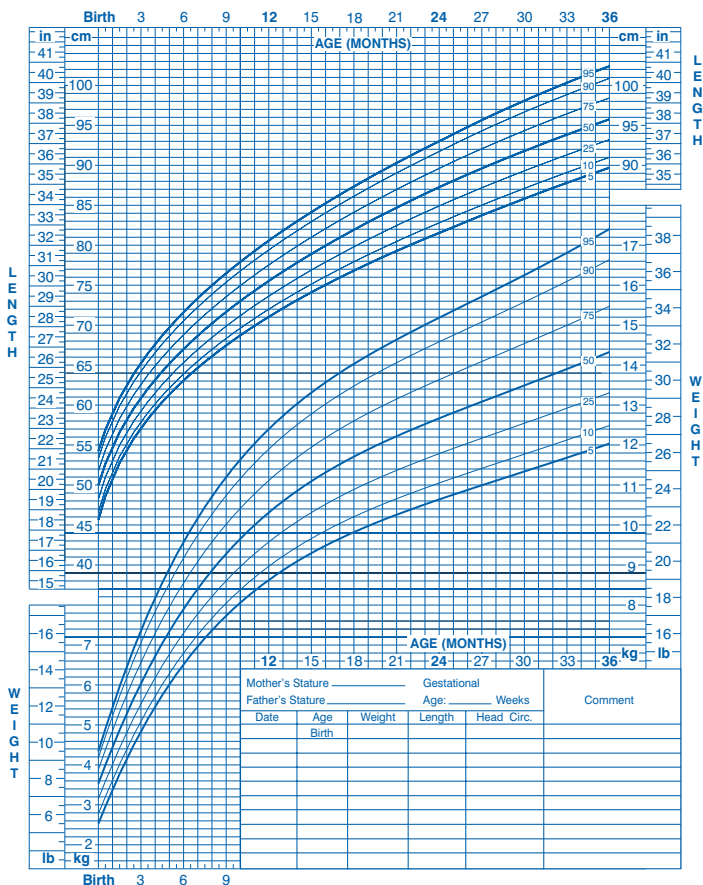


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Growth chart boys

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<http://www.cdc.gov/growthcharts>



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«Probably no other technology (food fortification) available today offers as large an opportunity to improve lives and accelerate development at such low cost and in such a short time...»

World Bank 1994

«In practice, vitamin and mineral deficiencies overlap and interact. Half of children with VMD are suffering from multiple deficiencies – adding up an immeasurable burden on individuals, on health services, on education systems, and on millions of families caring for children who are disabled or mentally impaired.»

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«For nearly 40 years , food fortification has protected the populations of the US, Canada, and many other countries. It is long past the time when the same protection was available to the people of the developing world.»

*Nevin Scrimshaw, President,
International Nutrition Foundation*

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