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*Edited by Richard Parker  
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## Global Nutrition

### Complex Aetiology Demands Social as well as Nutrient-Based Solutions

*Joanne Csete and Marion Nestle*

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#### Introduction

Nutrition is crucial to the course of chronic and infectious illness and other aspects of human health and well-being. In resource-constrained and wealthy countries alike, poor nutritional status contributes to the leading causes of morbidity and mortality. Nutrition should be an important element of health policy-making, programmes, and education in all countries, but often is not. This chapter reviews, briefly and selectively, global data on the nutritional status of populations, consequences of malnutrition, results of programmes designed to address malnutrition, and the challenges that remain.

Here, *malnutrition* refers to conditions that typically result from excessive, deficient, or unbalanced intake of essential nutrients, often complicated by illness. Malnutrition includes *overnutrition*, usually due to overconsumption of *macronutrient* (protein, fat, carbohydrate) calories and manifested as obesity. *Undernutrition* (protein-energy) is manifested as stunting (low height for age), wasting (low weight for height), and underweight (low weight for age). Undernutrition is often accompanied by deficiencies of essential vitamins and minerals (*micronutrients*). *Food insecurity*, which is closely related to malnutrition, means lack of access to sufficient food for an active and healthy life, whether at the level of individuals, households, or communities (FAO 2006).

#### Prevalence and consequences of malnutrition

##### *Protein-energy undernutrition*

The conditions of stunting, wasting, and being underweight are highly prevalent in the world, especially among young children. Sub-Saharan Africa has the highest regional prevalence of childhood stunting and wasting (Table 30.1). South Asia is the most nutritionally deficient Asian sub-region, with an estimated 40 per cent prevalence of stunting and 5.7 per cent severe wasting (Black *et al.* 2008: 245). India alone has an estimated 61 million young children who are stunted (Black *et al.* 2008: 246). Globally, over 177 million young children are stunted, and over 19 million are severely wasted. The proportion of young children who were underweight

Table 30.1 Prevalence of childhood undernutrition, 2005

Region	<5 children (millions)	% stunted (95% confidence interval)	% severely wasted (95% CI)	% underweight (95% CI)	Low birthwt (% <2500 g)
Africa	141,914	40.1 (36.8–43.4)	3.9 (2.2–5.7)	21.9 (19.8–24.0)	14.3
Asia	356,879	31.3 (27.5–35.1)	3.7 (1.2–6.2)	22.0 (18.5–25.6)	18.3
Latin America	56,936	16.1 (9.4–22.8)	0.6 (0.2–1.0)	4.8 (3.1–6.4)	10.0
All 'developing countries'	555,729	32.0 (29.3–34.6)	3.5 (1.8–5.1)	20.2 (17.9–22.6)	16.0

Stunting = height/age < 2 SD; severe wasting = weight/height; underweight = wt/age < 2 SD; standard deviations based on WHO child growth standards <http://www.who.int/childgrowth/standards/en/>.

Source: Black *et al.* 2008.

declined from 32 to 27 per cent from 1990 to 2006 in 71 low-income countries, but the smallest decline was in sub-Saharan Africa (UNICEF 2007).

A low body-mass index (BMI), defined as the weight of an individual (in kg) divided by the square of height (in m<sup>2</sup>), indicates undernutrition in adults. Women are considered undernourished with a BMI below 18.5 kg/m<sup>2</sup>. Over 20 per cent of women of child-bearing age in sub-Saharan Africa, South Asia, and Southeast Asia have BMIs below this threshold (Black *et al.* 2008: 244), and 40 percent of women aged 15–49 in India and Bangladesh.

The consequences of protein-energy undernutrition are dire; it underlies some 3.5 million deaths per year and 35 per cent of morbidity among young children (Black *et al.* 2008: 243), and is the single most important determinant of the global burden of disease (Caulfield *et al.* 2004). Among young children, the risk of death increases significantly with the degree of undernutrition; severe wasting has an overall mortality odds ratio of about 9.4 and severe stunting about 4.1 (Black *et al.* 2008: 247). Evidence from several countries suggests a direct relationship between undernutrition in early childhood and poor performance in school or cognitive function later in childhood (Victora *et al.* 2008).

Undernutrition has intergenerational causes and consequences. Young children who are stunted tend to have short stature as adults. Pregnant women of short stature face elevated risk of requiring caesarean sections (Black *et al.* 2008: 244), a risk factor for maternal and neonatal death where health services are inadequate. Low BMI among pregnant women is associated with intrauterine growth restriction (Black *et al.* 2008: 244), which is strongly linked to low birth-weight. Low birth-weight, in turn, is associated with neonatal morbidity and mortality, impaired growth and poor cognitive development (UNICEF/WHO 2004). In short, undernutrition puts millions of children at risk of death in young childhood, makes them more susceptible to serious illness, and impairs their capacity for educational attainment.

### Micronutrient undernutrition

Vitamin and mineral (micronutrient) deficiencies are widespread in adults and children in many countries. Among the most important of these are the following.

**Vitamin A:** An estimated 190 million children under the age of five (about one-third of all under-five children) and 19 million pregnant women, or about 15 per cent, are vitamin A-deficient, the vast majority in sub-Saharan Africa and South Asia (WHO 2009a).

This deficiency impairs the immune response to many infectious diseases, contributing to the premature death of an estimated 1 million young children annually (UNICEF and Micronutrient Initiative 2004). Severe vitamin A deficiency causes xerophthalmia and blindness.

*Iron-deficiency anaemia:* About 1.62 billion people in the world suffer from anaemia (based on haemoglobin levels); the prevalence is highest among pre-school children (47.4 per cent) and pregnant women (41.8 per cent) (de Benoist *et al.* 2008). Anaemia in pregnant women contributes to risk of maternal death, and anaemia in children to impaired cognitive development (Black *et al.* 2008: 249).

*Iodine:* Iodine deficiency is the most prevalent cause of brain damage in the world (WHO 2009b). Children born to women with severe iodine deficiency are at high risk of mental retardation. Even mild iodine deficiency among pregnant women can cause intrauterine growth restriction and impaired foetal brain and motor development. Some 38 million newborns per year are at risk of mental impairment because of iodine deficiency (Micronutrient Initiative 2009).

### Overnutrition

The World Health Organization (WHO) defines obesity and overweight as 'abnormal or excessive fat accumulation that may impair health', as measured by BMI: overweight is a BMI of 25 or above and obesity is a BMI of 30 or above (WHO 2009c: 1). By these definitions, an estimated 1.6 billion adults were overweight in 2005, and some 400 million were obese. By 2015, about 2.3 billion adults are projected to be overweight and over 700 million obese (WHO 2009c: 1). An estimated 20 million children under the age of five were overweight in 2005. Obesity is increasing rapidly in the global South, particularly in urban areas. From the mid-1980s to about 2005, obesity prevalence increased threefold in low- and middle-income countries exposed to 'Western' diets (Hossain *et al.* 2007). Obesity and undernutrition co-exist within single communities and even within families in many countries, constituting a 'dual burden' (Caballero 2005: 1514).

Overweight and obesity in adults are associated with a high risk of cardiovascular disease, the world's most frequent cause of death; diabetes, which WHO projects to double as a cause of mortality by 2016; musculoskeletal disorders; and some cancers (WHO 2009c). Based on disability-adjusted life years (DALYs), obesity accounts directly for about 16 per cent of the global burden of disease (Hossain *et al.* 2007: 213). Obesity in children is ushering in a previously unimaginable global epidemic of type 2 diabetes in adolescents, and is associated with cardiovascular disease risk factors as well as psychosocial problems (Ebbeling *et al.* 2002).

## Causes of malnutrition

### Undernutrition

It is tautological that nutritional outcomes are related to diet on an immediate level, but the aetiology of undernutrition is complex. Figure 30.1, an adaptation of the widely used United Nations Children's Fund (UNICEF) framework on causes of child malnutrition, suggests several levels of causation. Diet as an immediate cause of undernutrition is mediated by infectious illnesses such as diarrhoea and the high energy demands of fever. One intermediate factor is the lack of access to adequate water and sanitation and to affordable, good-quality health care that characterises many communities at risk of undernutrition.

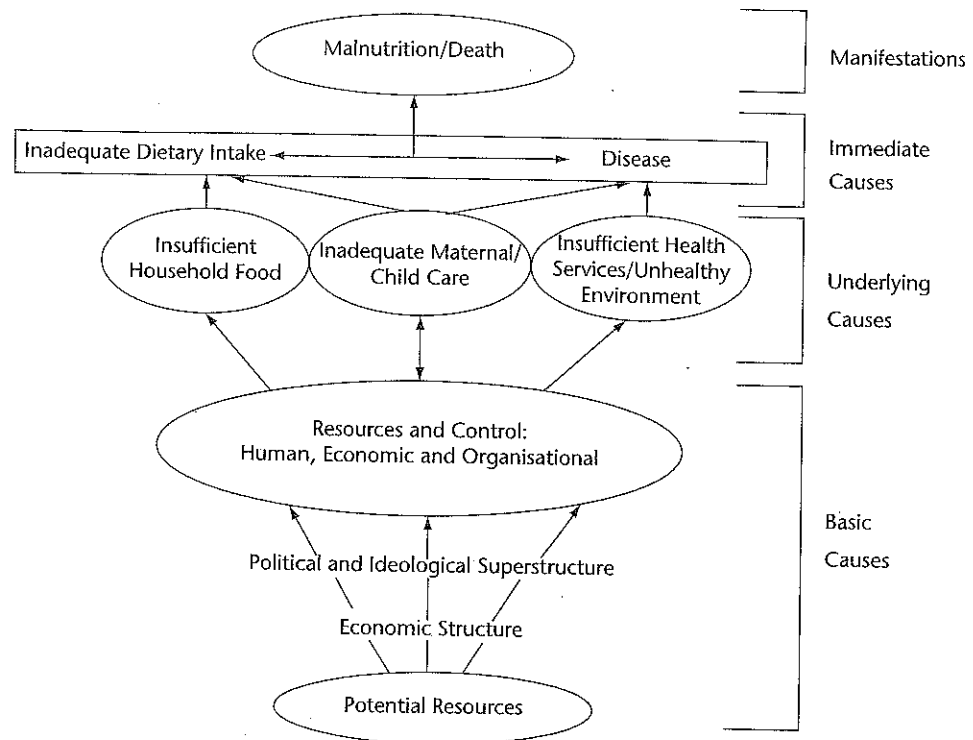


Figure 30.1 Causes of child malnutrition: UNICEF framework  
Source: UNICEF 1990.

### Food insecurity

Food insecurity is a function of poverty. The Food and Agricultural Organization's (FAO) count of 'hunger' or individual food insecurity topped 1 billion for the first time in 2009 (FAO 2009). The increase to 1.02 billion from the 2008 estimate of 915 million (up from 873 million in 2004–06) was explained by lower household income due to the global recession, as well as historically high staple food prices (FAO 2009). Sub-Saharan Africa and South Asia have the highest proportions of food-insecure people. Until 2007, most food-insecure persons were rural dwellers of countries of the global South, including landless farm families (Pinstrup-Andersen and Cheng 2007). With the recession of 2008–09, the majority of food-insecure people may still be rural, but millions of the newly food-insecure were poor urban-dwellers who lost low-paying jobs in recession-affected sectors (FAO 2009; Natsios and Doley 2009). Food riots occurred in more than 50 countries by mid-2008 (von Braun 2008), mostly in urban areas.

Although world food production has outpaced population growth since the 1980s (Holt-Giménez 2008), food prices have risen. Among the factors behind the price rise are increasing global demands for grain-intensive meat and dairy products (Natsios and Doley 2009), as well as diversion of grain crops to the production of biofuels (von Braun 2008). Many small farmers in food-insecure countries are not linked to global markets and do not easily benefit from higher food prices (von Braun 2008).

### *Child care and infant feeding*

Breastfeeding is well-known to convey immunological benefits to young children, protect against pathogens, and sustain good growth and cognitive development. Exclusive breastfeeding for the first six months of life is recommended by the WHO, but only about half of children under the age of two months in the global South are exclusively breastfed, and under 30 per cent from age two to five months (Black *et al.* 2008). Complementary foods added to breast-milk after six months must contain sufficient protein, energy, and micronutrients to meet a rapidly growing child's needs. Much stunting and wasting occurs in children from age six to twelve months and is linked to suboptimal complementary feeding (Black *et al.* 2008).

Breastfeeding and complementary feeding are undermined by poverty, women's lack of decision-making autonomy, unsupportive workplace conditions (Pelto *et al.* 2003), and aggressive marketing of manufactured infant foods. The International Code of Marketing of Breastmilk Substitutes, a voluntary code of conduct approved by nearly all United Nations (UN) member states, forbids marketing practices such as making unjustified health claims about infant formula, providing free samples to new mothers, and making donations to health professionals (WHO 1981). While 71 countries have incorporated some elements of the Code in national law (UNICEF 2009), it is still widely violated (Aguayo *et al.* 2003; IBFAN 2007). Breastfeeding promotion efforts were somewhat stymied by the recognition that HIV can be transmitted through breastfeeding (Labbok *et al.* 2004). Research has since shown that exclusive breastfeeding can minimise HIV transmission and may be the best option for many women with HIV (WHO 2006).

### *Overnutrition*

The global obesity epidemic is linked to the 'nutrition transition' – a shift from undernutrition to overnutrition usually associated with economic development (Popkin 2007). Nutrition transitions most likely to result in obesity include a combination of dietary change – increased consumption of foods high in saturated fat and sugar (the 'Western diet') – and decreased physical activity (Popkin 2003). An enormous increase in the consumption of sweetened beverages since the mid-1970s has contributed significantly to rapid global weight gain (Popkin 2007). The lowest-income people in the lowest-income countries are unlikely to be overweight, but in middle-income countries, lower-income people are at high risk of obesity since nutrient-rich, low-fat diets are usually more expensive in middle-income countries than cheap, energy-dense fast foods (Caballero 2005).

The marketing clout of large multinational food producers and retailers has successfully promoted the consumption of high-fat and sweetened foods and drinks (Popkin 2007). Food marketing expenditures in Southeast Asia, for example, tripled to US \$6 billion from 1984 to 1990 (Chopra *et al.* 2002: 954). Since eating habits and tastes are formed in childhood, marketing processed and sweetened foods to children can be an effective sales strategy. Fast food chains locate their outlets near schools and link marketing to movies and toys for children (Ebbeling *et al.* 2002; Nestle 2007). Marketing of sweetened drinks and junk food in schools is a pervasive practice in the US and parts of Europe (Ebbeling *et al.* 2002; Nestle 2007), and there is every reason to suppose it will continue to be replicated elsewhere.

## **Addressing malnutrition**

### *Undernutrition*

UN member states committed to pursuing the goal of reducing 'hunger' by half from 1990 to 2015 as part of the Millennium Development Goals (MDG). Progress will be measured by



estimating the proportion of under-five children who are underweight for age and the percentage of people consuming a minimum level of calories (MDG Monitor 2009). The goal does not mention micronutrient undernutrition or obesity.

In 2008, the Child Undernutrition Study Group, an eminent expert body, conducted a comprehensive review of interventions for which there was some evidence of effectiveness. The Group concluded that evidence justified implementation of several interventions in all countries where child undernutrition is a significant problem: for children – breastfeeding and complementary feeding promotion, vitamin A supplementation and salt iodisation, treatment of severe wasting, and zinc in management of diarrhoea; and for women of child-bearing age – iron, folate, and calcium supplementation, smoking cessation, and reduction of exposure to indoor air pollution (Bhutta *et al.* 2008). By a different criterion – the reduction of child mortality – optimal breastfeeding is judged to be the most effective investment that countries can make, and improved complementary feeding the third most effective (insecticide-treated bed nets for malaria prevention is second) (Labbok *et al.* 2004).

Although not mentioned in the MDG, micronutrient deficiencies have become a priority for major donors. They are the low-hanging fruit of nutritional challenges, lending themselves to technical solutions that do not necessarily involve improving access to food, reducing poverty, or addressing social determinants of malnutrition. As of 2005, 34 countries had iodised virtually all table salt, which effectively protects against iodine deficiency, and 60 countries had significantly increased availability of iodised salt since 1995 (UNICEF 2007). Trends in vitamin A deficiency are more difficult to discern, but there is some indication that serum retinol levels improved among pre-school children from 1995 to 2009 (WHO 2009a), probably linked to large-scale supplement distribution. From 1999 to 2005, the number of children receiving supplements rose fourfold (UNICEF 2007). Iron deficiency anaemia, however, has been less amenable to such rapid improvement. Available data do not reveal consistent trends, but all surveys reviewed by WHO indicate very widespread anaemia in all regions (de Benoist *et al.* 2008: 12) despite efforts at iron fortification of staple foods.

The Global Alliance for Improved Nutrition (GAIN), a 'public-private partnership' focused on creating markets for micronutrient-fortified foods, may be the world's largest single programme targeting undernutrition, as it is supported by the Gates Foundation, many food companies, bilateral donors, WHO and UNICEF (GAIN 2009a). As of 2008, GAIN estimated that 99 million women and children were consuming fortified staples as a result of its work (GAIN 2009b). A promising initiative in some settings has been 'home fortification', using low-cost sachets of micronutrient-rich powders or 'sprinkles' containing iron that can be added to meals (Micronutrient Initiative 2009). Sustainability of supply and affordability of these products present challenges.

With regard to childhood protein-energy undernutrition, prevention is of course desirable, but immediate treatment of severe undernutrition, especially childhood wasting, is urgent to avert death. The treatment of severe wasting has been transformed since 2000 by use of energy-rich, micronutrient-dense, ready-to-use therapeutic foods (RUTF) (WHO *et al.* 2007). WHO lauds RUTF as a means of enabling severely wasted children to be treated effectively without expensive hospitalisation (WHO *et al.* 2007). The most widely used RUTF, a micronutrient-fortified groundnut and milk paste (WHO *et al.* 2007), is so calorie-dense that it is not surprising that adding it to a child's diet quickly reverses wasting, but sustaining the cost-effective provision of RUTF and preventing relapse of children when they have finished RUTF regimens are ongoing problems.

As noted above, enabling women to breastfeed optimally would avert childhood mortality and undernutrition better than any other single measure. The momentum behind global programmes in this area has declined recently, perhaps in response to the combined effects of

confusion about HIV and breastfeeding, unrelenting marketing of infant formula by manufacturers, and 'message burnout' after decades of promotion (Labbok *et al.* 2004). Several studies have demonstrated the effectiveness of providing individual or group-based support to encourage exclusive breastfeeding of young children and optimal complementary feeding (Bhutta *et al.* 2008), but only rarely can these programmes be sustained at a level that can counter the marketing might of formula companies (IBFAN 2007).

Ultimately, in addition to access to affordable, good-quality health services, combating undernutrition depends on access to a nutritious and varied diet, something that, as the MDG concludes, is closely linked to reducing poverty. Although a complete discussion of approaches to reducing food insecurity is beyond the scope of this overview, it is worth noting a renewed debate about supporting agricultural production in food-insecure areas, an important element of food security. Green Revolution approaches for Africa have been boosted by a major investment in this area by the Gates Foundation (2009). Critics argue that while yields of wheat and rice increased markedly in response to Green Revolution breakthroughs in the 1960s and 1970s, they came at the price of environmental devastation, as they require high levels of pesticides and petroleum-based fertilisers, and encourage export agriculture and industrial-scale monoculture (Holt-Giménez *et al.* 2006). Such approaches also undermine traditional eco-systems based on varied crops and animal husbandry (Oxfam International 2009; Shiva 2000).

### Overnutrition

Efforts to prevent obesity must address both diet and physical activity – the two parts of the obesity equation – and must reach people as early in life as possible (Nestle and Jacobson 2000). Ebbeling and colleagues (2002: 478) concluded that in the US and UK behavioural and educational interventions were overwhelmed by 'adverse environmental factors', of which the most adverse was extravagantly funded marketing of fast food and soft drinks, especially in schools. This conclusion echoes Nestle's (2007) analysis of aggressive marketing in the US of high-energy, nutrient-poor foods passed off as 'healthful' while powerful food industry lobbyists in Washington work to weaken government dietary guidelines and marketing regulations. Food company sponsorship of children's television programmes is largely forbidden in Norway, Sweden, and Finland (Kaiser Family Foundation 2004). Such a measure seems unlikely in the US and other countries in which state interference with private commerce is politically unpalatable.

WHO's Global Strategy on Diet, Physical Activity and Health was designed to address the growing disease burden associated with overnutrition (WHO 2004). The Strategy cites the food industry as a 'partner' with governments in fighting obesity and suggests that it 'consider introducing new products with better nutritional value' and 'practice responsible marketing ... especially to children' (WHO 2004, para 61). A 2003 WHO background report meant to contribute to the Global Strategy recommended that added sugars comprise less than 10 per cent of daily calorie intake. Following pressure from the Bush Administration, with its close ties to the sugar industry, that recommendation did not appear in the Global Strategy (Nestle 2007: 379). Some experts have criticised the Global Strategy for depicting the food industry as an ally (Chopra *et al.* 2002) and recommend binding regulations on food marketing along the lines of the Framework Convention on Tobacco Control (Chopra and Darnton-Hill 2004).

### Conclusion

Both undernutrition and overnutrition are closely linked to poverty. Even in wealthier communities, the poorest people are most constrained in acquiring nutritious food. Malnutrition is



an intransigent problem with no simple solution. Most nutrition interventions are not linked coherently to anti-poverty programmes or well-integrated into health programmes (Morris *et al.* 2008). On the global health agenda, most aim only to improve diet; they intervene at the level of immediate causes and are not linked to basic or even intermediate determinants of nutrition outcomes.

As globalisation opens doors for new solutions to worldwide health problems, it also increases the reach and power of multinational corporations. Every element of the complex causation of malnutrition cannot be addressed in all programmes, even by large multilateral bodies, but it should not be too much to expect that national and multilateral authorities pay attention to the actions and motives of for-profit food companies. More assistance is needed to translate the voluntary Breastmilk Code into national law and to support countries in prosecuting offenders. More countries should follow the lead of Sweden, Norway, and Finland in establishing legally binding restrictions on unethical advertising of unhealthy foods to children.

Improving food security will always be challenging, particularly since it affects both rural people who depend on marginal land and fragile soils and the growing millions of urban poor (Oxfam 2009). The kind of food production compatible with good nutritional and environmental outcomes is the subject of vigorous debate. Proponents of small-scale, low-input agriculture argue that it can feed the world by sustainably feeding each corner of it (Chappell 2007); agribusiness has a different view. The debate may be tipped when important donors such as the Gates Foundation – with over US \$60 billion in assets and a hands-on approach to giving (Black *et al.* 2009) – enter the scene. The world may never know the full potential of eco-friendly low-input agriculture if assistance to food-insecure countries is dominated by a vision of narrow and corporatised technical solutions to address complex social, economic, and environmental challenges.

Successful approaches to reducing malnutrition require leadership that is independent, evidence-based, and multidisciplinary. The independence of nutrition research and policy has been too often compromised by ties to the food industry or agribusiness (Lesser *et al.* 2007; Nestle 2007:116–20). The vision of nutrition science for reducing malnutrition has not often enough taken into account the full range of constraints faced by the poor, leading some nutritionists to call for approaches to malnutrition that take better account of social, environmental, cultural, and political determinants of nutrition outcomes (Cannon and Leitzmann 2005). Finally, effective solutions are unlikely to suggest themselves without meaningful participation in nutrition decision-making by those who live every day with nutritional deprivation.

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