# International Nutrition

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While the study of global health has traditionally been of particular interest to those working in international health agencies or in developing countries, today's world makes it essential for all health professionals to understand the global forces shaping people's health. The AIDS epidemic, the emergence of new communicable diseases, and the global epidemic of obesity are examples of major domestic public health issues closely linked to the global situation. In addition, the dramatic expansion in travel and communications and the globalization of the economy are weakening cultural and geographic barriers and exposing a variety of populations to similar dietary and lifestyle factors affecting risk of disease. In this chapter, we focus on global factors affecting child survival, growth, and well-being.

## CHILD MORTALITY AND SURVIVAL: GLOBAL TRENDS

Over 10 million children die each year, the majority of them in developing countries. A child born in the less developed world today has a life expectancy of 52 years. Major threats to survival are poverty, war, and HIV/AIDS.[1] In relative terms, children are more exposed to poverty because they constitute a much larger proportion of the population in poorer than in richer countries. While in industrialized countries children <18 years represent 21% of the total population, they constitute 49% of the population of the least developed countries. Similarly, 16% of children in poorest countries are <5 years of age, compared with only 6% in developed countries.[2]

Children in the poorest countries have a significantly higher risk of dying before the age of 5 years. Income inequality, that is, the range between the top and bottom quartile of income distribution, is one key predictor of child mortality risk, and closely tracks disparities in mortality. For example, in Latin America, the region with the highest household income inequality in the world, Peruvian children living in the lower 20% of income are five times more likely to die before the age of 5 years than those in the upper 20%.[2] The geographic distribution of world child deaths is shown in Figure 1.

Mortality is the end result of a complex interaction of health, nutritional, and environmental factors, but it is generally acknowledged that prior nutritional status and current dietary intake are key factors,[4–6] particularly breast-feeding duration and timing of introduction of complementary foods.[7–9] Other determinants include access and utilization to prenatal care,

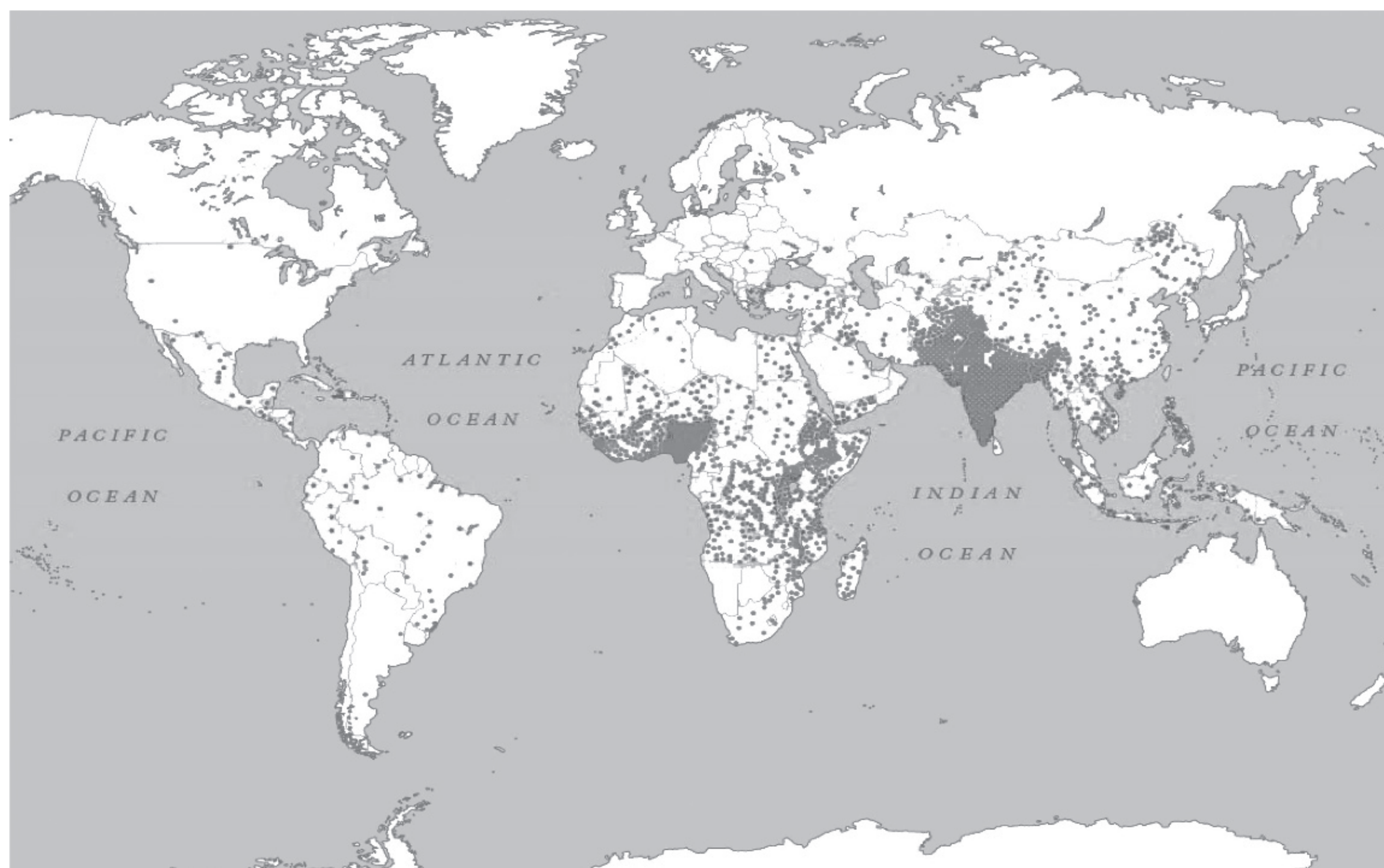


**Figure 1** Geographic distribution of global child deaths. Each dot represents 5,000 deaths. (Reproduced with permission from reference 3.)

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**Table 1 Global Trends in Childhood Mortality Rates, 1990 and 2004**

| | Under-5 Mortality Rate* | | Infant Mortality Rate† (Under 1) | |
|---|---|---|---|---|
| | 1990 | 2004 | 1990 | 2004 |
| World | 95 | 79 | 65 | 54 |
| Industrialized countries | 10 | 6 | 9 | 5 |
| Developing countries | 105 | 87 | 72 | 59 |
| Least developed countries | 182 | 155 | 115 | 98 |
| Sub-Saharan Africa | 188 | 171 | 112 | 102 |
| Middle East and North Africa | 81 | 56 | 59 | 44 |
| South Asia | 129 | 92 | 89 | 67 |
| East Asia and Pacific | 58 | 36 | 43 | 29 |
| Latin America and Caribbean | 54 | 31 | 43 | 26 |
| CEE/CIS and Baltic States | 54 | 38 | 44 | 32 |

Source: UNICEF.[2]
CEE = central eastern Europe; CIS = Commonwealth of Independent States.
*Per 1,000 live births.
†Per 1,000 live births, at exactly one year of age.

immunizations, maternal education, and access to electricity.

The major causes of death in children <5 years are pneumonia (19%), diarrhea (13%), and malaria (9%). Neonatal deaths of different causes constitute over 40% of the total death in children under 5 years. Child mortality rates continue to decline in almost all regions of the world. Figures for world regions as defined by the United Nations are presented in Table 1.[2,4,5] In spite of this overall trend, there are substantial disparities among countries: almost half of all child deaths occur in only six countries, and the gap between mortality rates in developed countries and in the poorest regions has widened from 20-fold in 1990 to 29-fold in 2000.[3]

Major factors driving the reduction in child mortality were increasing coverage of immunization campaigns, widespread use of oral rehydration therapy, and promotion of breast-feeding.[10] Integrated programs that combine promotion of breast-feeding with immunizations and micronutrient supplementation, and improved access to prenatal care were also important contributors.[11] However, trends toward reduction in mortality were partially offset in some cases by economic decline and social and political instability.[4,12]

## Nutrition, Growth, and Mortality

Undernutrition (low body weight) is associated with as much as 60% of deaths during the first 5 years of life. In the developing world, underweight and micronutrient deficiencies (such as vitamin A and zinc) are major contributors to the high mortality rates from diseases such as pneumonia, malaria, diarrhea, and measles. About one of every four children under 5 years of age in the developing world have a weight deficit (underweight), totaling around 146 million children.[1] About half of these children are in only three countries: India, Bangladesh, and Pakistan. Boys and girls are similarly affected, but children in rural areas are more likely to be undernourished compared with urban children.

*Stunting* or chronic malnutrition refers to the child with a length or stature below a defined minimum cutoff (usually the fifth percentile for age) but with a normal weight-to-height proportion. Stunting is usually the result of repeated acute episodes of growth deceleration, most commonly related to infectious episodes.[13–15] Current (1999 to 2004) data on prevalence of the different forms of protein-energy malnutrition are presented in Table 2.

**Table 2 Current Prevalence of Low Birth Weight and Malnutrition**

| | Percentage of Infants With Low Birth Weight | Percentage of Under-5 with Moderate or Severe | | |
|---|---|---|---|---|
| | | Underweight | Wasting | Stunting |
| World | 16 | 26 | 10 | 31 |
| Industrialized countries | 7 | — | — | — |
| Developing countries | 17 | 27 | 10 | 31 |
| Least developed countries | 19 | 36 | 10 | 42 |
| Sub-Saharan Africa | 14 | 28 | 9 | 38 |
| Middle East and North Africa | 15 | 14 | 6 | 21 |
| South Asia | 31 | 46 | 14 | 44 |
| East Asia and Pacific | 7 | 15 | — | 19 |
| Latin America and Caribbean | 9 | 7 | 2 | 16 |
| CEE/CIS and Baltic States | 9 | 5 | 3 | 14 |

Source: UNICEF.[2]

Over the past two decades, a consistent decline in stunting has been documented. In 1980, 41% of children under 5 years of age had some degree of growth retardation for their age. By 2005, estimates put that figure at 32%, still leaving about 192 million children with inadequate growth.[10]

The geographic distribution of stunting is far from uniform. While one-third of children in the developing world are currently defined as stunted, 70% of these children live in Asia (61% of the total number reside in South Asia), 26% in Africa, and the remaining 4% in Latin America and the Caribbean. Similarly, while the overall trend is in decline, a slight increasing trend (of about 0.08%/yr) is observed in sub-Saharan Africa.[10] Table 2 depicts trends in stunting in UN regions from 1980 through 2005.[1,16]

Several studies have demonstrated an inverse correlation between stunting, cognitive, and physical development in young children, and consequently lower intelligence levels in older children, and functional impairment in adulthood, in terms of both intellectual and physical aspects, impairing work capacity. Stunting also increases obstetric risk in women, and also has a transgenerational effect leading to the perpetuation of suboptimal growth in the population as a whole.[17]

*Wasting*, usually measured by weight-for-height, is an indicator of acute malnutrition. A low weight-for-height can occur in a previously healthy child, but more commonly it affects populations of children who are already suffering from chronic malnutrition (stunting). Acute weight loss may be linked to inadequate dietary intake due to illness, or simply to unavailability of food, such as in natural or man-made disasters that suddenly displace populations from their natural habitat. Values 2 standard deviations below the median value are considered moderate wasting, with <3 standard deviations defining severe wasting. Wasting can also be estimated using the mid-upper arm circumference, a more rapid assessment method frequently used in refugee camps to triage emergency assistance.[18,19] Severely wasted children lose most of their subcutaneous fat, as well as some of their muscle mass, resulting in a very low mid-upper arm circumference.

Recent global data indicate that 10% of children are moderately to severely wasted (Table 2). Wasting has a low-to-moderate prevalence in Latin America and the Caribbean, and high prevalence in South Asia. In Africa prevalence shows substantial variability across countries, with an increasing trend from West to East. Sub-Saharan Africa, which has the highest rate of stunting in the world, shows only low-to-moderate rates of wasting.[16]

Whereas stunting has long-term implications for adult health and productivity, wasting is closely linked to child mortality.[20,21] By increasing the frequency and severity of infectious diseases, acute malnutrition significantly increases mortality from communicable diseases.[22–24]

In 2006, WHO released new growth curves for the assessment of child growth derived from

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the Multicenter Growth Reference Study conducted between 1997 and 2003. Detailed anthropometric measurements were obtained from infants from Brazil, Ghana, India, Norway, Oman, and the United States who were exclusively breast-fed for at least 4 months, partially breast-fed for at least 12 months, and whose mothers did not smoke cigarettes. These curves, included in Appendix I, “Nutritional Assessment” are designed to be the international standard for growth between birth and age 5, as well as to establish the breast-fed infant as the normative model for growth and development. See Chapter 2, “Clinical Assessment of Nutritional Status” for more details about these and other growth curves.

**Fetal Growth and Birth Weight**

Twenty-one of the twenty-five million low-birth-weight (LBW: <2500 g) infants born every year are in the developing world. Birth weight is a potent indicator of infant growth, response to environmental stimuli, and ultimately to infant survival. LBW infants have a 10-fold higher risk of neonatal mortality compared with newborns weighing 3 to 3.5 kg.[21,25] The prevalence of LBW in the developing world ranges from 9% in Latin America to 31% in South Asia.[2] Rates for each world region are shown in Table 2. Whereas prematurity is the main contributor to LBW in the developed world, the vast majority of LBW infants in developing countries are small for gestational age, reflecting intrauterine growth retardation (IUGR). The more common type of IUGR in the developing world is symmetric IUGR, indicating a sustained energy restriction throughout pregnancy. Hypoglycemia, hyperviscosity, hypothermia, perinatal asphyxia, and aspiration are more frequent in the wasted neonate. These findings persist despite correction for both birth weight and gestational age.[26]

In the developing world, maternal prepregnancy weight is strongly correlated with birth weight. A low prepregnancy body mass index is associated with higher morbidity and mortality for both mother and fetus.[23] Thus, there is an intergenerational effect of stunting, since stunted girls reaching their reproductive age will have an increased risk of producing low-birth-weight babies. Maternal behaviors and cultural factors determining level of physical activity and food intake also influence energy balance during pregnancy.[23]

In addition to dietary energy, micronutrient deficiencies can significantly affect fetal growth, as well as impact on obstetric mortality. Vitamin A deficiency appears to have a significant effect on maternal mortality, as suggested by studies in Nepal where vitamin A supplementation reduced mortality by 30%.[27] Other studies in Nepal by the same researchers reported that prenatal folic acid and iron supplementation had modest positive effects on birth weight.[28] There is increasing interest on the role of zinc deficiency on gestational outcomes. While most studies have failed to document a clear beneficial effect of zinc supplementation on birth weight, significant effects have been reported for fetal neurobehavioral development.[29,30] Additional maternal factors increasing the risk of LBW are low maternal age (<18 years), chronic infections, such as malaria, gastrointestinal parasites, STDs, first time births, the latter also seen in the industrialized world.[25]

The implications of IUGR extend beyond those of anthropometrics and growth. Studies in the developing world have reported lower Bayley scores and lower mental development index scores in low-birth-weight infants. These findings, however, are associated with environmental factors as well, such as standard of living, housing, and parental education. The trends in these studies would suggest that cognitive development and deficits change over time, and many of the conclusions drawn are dependant at the age at which they are actually followed up, and may actually be transient.[31–33]

The Guatemala longitudinal study[15] documented some degree of catch-up growth of infants with IUGR during the first 2 years of life, with subsequent stabilization at the centiles achieved by that age. Body weight and height deficits in 17- to 19-year-olds were evident, averaging 5 kg and 5 cm below non-IUGR children.[34,35]

Prevention of IUGR in developing countries has centered on improving nutritional status of women of reproductive age, providing access to prenatal care, malaria prevention and treatment, tetanus immunization, and reduction of tobacco exposure.[36–38]

## THE INTERACTION OF NUTRITION AND INFECTION

The vicious circle of protein-energy malnutrition, impaired immune response, increased infections, and decreased food intake has been well recognized since the seminal work of Scrimshaw et al.[39] Malnutrition affects most of the host defense systems against infection, including epithelial and mucosal integrity, mucociliary clearance, gastric acid production, immunoglobulin synthesis, and lymphocyte differentiation.[24,40] Micronutrient deficiencies, particularly of vitamin A and zinc, also result in severe impairment of host resistance mechanisms. The role of vitamin A on the immune system and on infectious disease morbidity and mortality has been extensively studied.[41,42] The evidence from field trials led to the widespread policy of administering vitamin A as part of the acute infection management of children at risk of hypovitaminosis A. The role of zinc deficiency on susceptibility to infection and the efficacy of supplementation to reduce infection morbidity and mortality was explored in several field trials,[43,44] showing that zinc supplementation significantly reduces the incidence of pneumonia and diarrhea, with a modest but significant effect on mortality as well.

The cumulative effect of mild but repeated infectious episodes on child growth has been well documented in a variety of settings in the developing world[13,45–48]; Figure 2 depicts the growth pattern of a child in the village of Santa Maria Cauque, Guatemala. Decreased dietary intake due to anorexia or withholding of food by caregivers, excess nutrient losses, and increased nutrient requirements are the usual mechanisms by which infection aggravates nutritional status. In addition, the immune response to infection induces a catabolic state that may persist beyond the clinical course of the infectious episode, as shown by the pioneering studies of

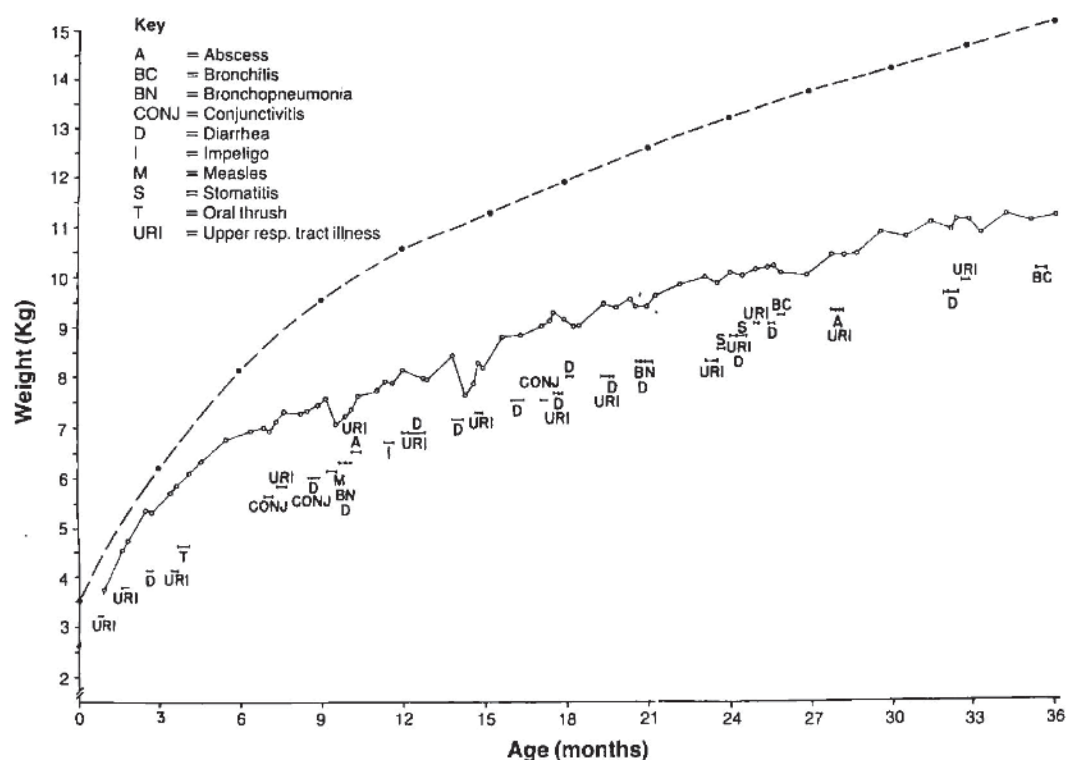


**Figure 2** The impact of repeated infections on growth of a child in rural Guatemala. The solid line represents the weight of the child; the broken line is the 50th percentile of reference weight standards (INCAP, 1956). Horizontal lines above disease codes indicate duration of each infectious episode. (Reproduced with permission from reference 13.)



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Beisel et al.[40] A novel mechanism for the nutrition–infection interaction was described in mice, consisting on mutation of the viral genome by selenium deficiency in the host, resulting in enhanced or newly acquired virulence.[49]

The vicious circle of infection-impaired nutrition–infection results in a significantly higher morbidity and mortality when an infection affects a malnourished host. This increase in mortality is more or less proportional to the severity of the underlying protein-energy malnutrition. It is estimated that an impaired nutritional status contributes to 56% of deaths due to infectious diseases in children.[22]

## EARLY GROWTH PATTERNS AND ADULT DISEASES

The long-term effects of early nutritional experiences have received increasing attention since the emergence of the so-called Barker hypothesis (also known as the "fetal origins" hypothesis), linking prenatal undernutrition to risk for chronic diseases in adulthood.[50] This phenomenon was first documented by Widdowson, who showed that a short-term food restriction in rats had dramatically different effect depending on when it occurred in the life cycle of the animal. An early restriction caused a permanent change in food intake and thus in growth rate, whereas a restriction after weaning was quickly compensated by transient overeating and catch-up growth. There is now a consistent body of evidence, both from descriptive epidemiological studies and from biological experiments, documenting the impact of early growth and metabolic differentiation on long-term risk of disease.[50–58] Figure 3 depicts the association between birth weight and risk of type 2 diabetes as shown in one of the early reports by Phipps et al.[59]

One central proposition of the fetal origins hypothesis is that fetal adaptation to a limited energy supply (commonly due to maternal malnutrition or placental dysfunction) is achieved at the expense of selective differentiation of certain metabolic pathways and physiological functions. This differentiation, although it may have short-term benefits for survival, may later in life become detrimental to health, when energy supply is plentiful.[60] An example would be the maximization of energy conservation pathways when there is a deficient maternal energy supply. This response, if irreversible, may result in an increased risk of obesity later in life, particularly in face of unrestricted dietary energy availability.[57,61–65] Similar explanations have been put forth to explain hypertension risk based on restricted placental blood flow, and diabetes risk based on impaired glucose supply.[55,66–70]

Some evidence points to type and timing of feeding during the first 12 months of life as another important factor impacting on chronic disease risk in the adult. Of particular interest is the role of breast-feeding. Overall, published studies suggest a modest protective effect of breast-feeding against adult obesity.[71–73] For further discussion of these concepts, please see Chapter 27, "Human Growth and Disease in Later Life."

## MICRONUTRIENT MALNUTRITION

Single- and multiple-nutrient deficiencies are widespread, affecting over 2 billion persons worldwide, mostly but not only in developing countries. Iron deficiency is considered the most prevalent single-nutrient deficiency, affecting more than 1 billion persons, followed by hypovitaminosis A and iodine. The global prevalence of deficiencies for vitamin A, iodine, and iron is presented in Table 3. There are less data on the global prevalence of zinc, calcium, and folate deficiencies, but most estimates consider deficiency of these nutrients more widespread than recognized earlier. Infectious diseases are an important contributor to micronutrient deficiencies. They increase gastrointestinal losses and may impair effective utilization of dietary sources as well. Conversely, micronutrient deficiencies may increase susceptibility to infection, as noted above.[31,74]

Vitamin A deficiency is one of the major single-nutrient deficiencies in the world. Every year there are about 10 million new cases of xerophthalmia in children. Indirect estimates indicate that vitamin A deficiency affects 130 million preschool-age children worldwide, with 1 to 2 million dying each year.[41] Among the many factors contributing to this deficiency are low consumption of animal protein sources, reduced bioavailability and bioconversion of dietary provitamin A (beta-carotene), and excess losses during episodes of acute infection.

Traditionally linked to blindness, the role of vitamin A deficiency on child mortality was demonstrated by the landmark studies of Sommer et al[75–79] in the early 1980s, showing that a single large dose of vitamin A resulted in a 30% reduction in child mortality. Numerous subsequent trials in different countries have confirmed those findings, yielding on average a reduction of about 20% in mortality.[80] Supplementation is now national policy in most countries with endemic hypovitaminosis A. The effect of vitamin A on mortality is likely due to its positive effects on integrity of epithelia, cell differentiation, and the immune system, thus reducing the severity of many infectious diseases, particularly gastrointestinal and respiratory.[78,81]

It has been postulated that micronutrient content of breast milk is dependent on maternal intake for some micronutrients, but independent for others. Vitamins A and B complex and iodine are expressed in lower concentrations in the case of relative maternal deficiency, but increase in response to maternal supplementation. Vitamin D, folate, zinc, iron, and calcium are maintained at relatively stable concentrations in breast milk, even in maternal deficiency states.

Multiple-nutrient deficiency is receiving increasing attention, particularly during reproductive age. The role of folic acid on pregnancy is well recognized in developed countries, but there is less information for developing countries, where populations are likely to present folic acid deficiency combined with other micronutrient deficiencies. Recently completed field trials have yielded rather disappointing results on the impact of prenatal supplementation with multiple micronutrients on infant mortality[27] and birth weight,[28] indicating that they are not more effective than folic acid plus iron only. A trend toward higher maternal mortality in the group receiving multivitamin minerals needs further evaluation. It was suggested that an enhanced fetal growth and birth size might increase obstetric risk in a chronically undernourished mother.[82]

### Combating Micronutrient Malnutrition

Based on the evidence from numerous field trials showing significant benefits from micronutrient supplementation, several countries have implemented regional or national supplement distribution programs. While the supplement themselves are usually inexpensive, the logistics of mass distribution (transportation, coverage, etc) are complex and difficult to sustain over time.[83,84] Distribution

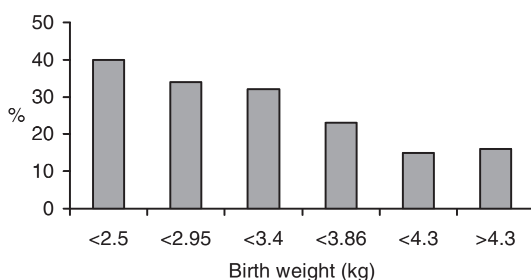


**Figure 3** Association of birth weight with risk of impaired glucose tolerance (IGT) and noninsulin-dependent diabetes (NIDD) in adulthood. (Adapted from reference 59.)

**Table 3 Extent of the Major Micronutrient Deficiencies in Different World Regions (in Millions of Persons)**

| Region | Iodine | | Vitamin A | | Iron* |
|---|---|---|---|---|---|
| | At Risk | Affected | At Risk | Affected | |
| World | 1,005 | 225 | 190 | 13.8 | 2,150 |
| Europe | 82 | 14 | — | — | 27 |
| Eastern Mediterranean | 33 | 12 | 13 | 1.0 | 149 |
| Americas | 55 | 30 | 2 | 0.1 | 94 |
| South and Southeast Asia | 280 | 100 | 138 | 10.0 | 616 |
| Africa | 150 | 39 | 18 | 1.3 | 206 |
| Western Pacific and China | 405 | 30 | 19 | 1.4 | 1,058 |

Source: WHO.[4]
*With and without anemia.

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programs, therefore, are considered an interim response to endemic deficiencies, with the ultimate goal of ensuring adequate intake through locally available foods, with or without fortification. Nevertheless, given the complexity of factors affecting food availability and intake in different populations, it is likely that micronutrient supplementation will continue to be a cost-effective option for the immediate future.

Food fortification is a powerful approach to combat micronutrient malnutrition. Although its implementation and sustainability is more complex than for supplement distribution, it can take advantage of the market forces and food distribution channels, requiring little direct involvement from the target population. The requirements for a successful fortification program have been well defined.[84] A number of countries have implemented fortification programs with varied degree of success. Salt iodization has reduced the incidence and prevalence of iodine-deficiency–related diseases, including cognitive and mental impairment, growth failure, and cretinism on a global scale. Similarly, folic acid fortification had a significant impact on the prevalence of neural tube defects.

Agricultural policies can provide incentive to rotate crops and to enhance the diversity and yield of foods grown and available. Agricultural technology, selective crop breeding, and transfer of technology may aid in increasing the micronutrient content of particular foods. Subsidization of certain seed types and of fertilizers may aid in encouraging the horticulture of certain crops as well. Finally, sustainability will ultimately depend on progress in educating consumers and on the overall behavioral change of the population.

## THE NUTRITION TRANSITION

The dramatic advances in communications and transportation and the globalization of economic markets are promoting rapid changes in diet and lifestyle in developing countries. This phenomenon, often termed the nutrition transition, is a key factor in the changing disease patterns for developing countries. Projections from data for the past decade indicate that by the year 2020, chronic, noncommunicable diseases will account for 70% of the disease burden in these transitional countries.[85] This in turn will impose tremendous demands on the health care system of these countries, currently geared predominantly toward maternal and child care. A detailed analysis of the nutrition transition can be found elsewhere.[86]

Urbanization, which occurs at a faster pace in the developing world, is having a profound effect on dietary patterns and lifestyle. The UN predicts that almost 90% of the projected population growth for the next 20 years will occur in urban areas of the developing world (Figure 4). Thus, the absolute number of persons whose diet and lifestyle will be modulated by the urban environment will increase dramatically.

The urban environment has important effects on dietary and lifestyle patterns. Consumption of

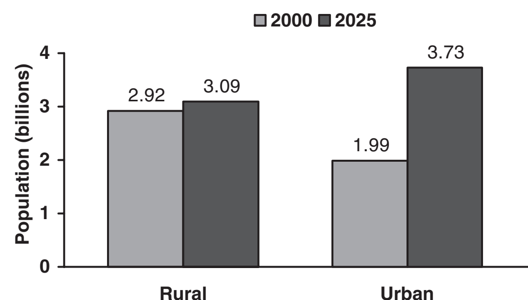


**Figure 4** Actual and projected population growth, 2000 and 2025. Relative population increases in urban and rural areas. (Data from the UN Population Council.)

processed foods, usually of higher fat content, and total dietary energy intake tends to increase.[87] Urban families become dependent on the cash food market, which exhibit high price elasticity, thus having the potential for driving food choices in low-income populations.[88] Daily energy expenditure in the urban setting is usually substantially lower than in rural areas. The intense physical labor of rural work in the fields is replaced by sedentary, low-energy work of service jobs or automated manufacturing.[88,89] Television viewing is also a well-documented factor in increasing physical inactivity in adults and adolescents. The combined effect of an increased energy intake and a reduced energy output is weight gain and obesity. In addition, sedentary lifestyle per se carries an increased risk for cardiovascular diseases.[90] The impact of urban dwelling on obesity prevalence has been documented for several regions in the developing world. Childhood obesity has increased steadily in developed and developing countries. A recent global assessment by Wang and Lobstein predicts that by the year 2010 obesity rates will reach over 20% in China, India, and countries in East Asia.[91] In countries of intermediate development (with a GNP of ~$2,000/yr) a phenomenon called "dual burden" of disease is emerging, in which under- and overnutrition can be present in the same household, usually an underweight child with overweight adults.[92] This suggests that, as the economic growth of a country advances, obesity risk tends to switch from the upper to the lower socioeconomic groups, which also continue to have substantial rates of undernutrition. The association between under-and overweight is obviously complex, and is affected by a number of factors such as urbanization, demographic profile, and others.[93]

## CONFRONTING THE CHALLENGE OF THE NUTRITION TRANSITION

The World Health Organization has recognized diet- and lifestyle-related chronic diseases as a strategic challenge for world health, and has defined a blueprint for action at the global and local level.[94] Several countries have begun to consider the long-term implications of their socioeconomic changes on the health of their population as well. Local and national initiatives to improve dietary patterns and increase physical activity have been proposed or implemented.[95,96] Other countries like China are testing regional programs to promote healthy eating and lifestyle, particularly in the urban population. There are some comprehensive experiences in preventive interventions in developed countries, which can provide insight into effective approaches. Among these the Karelia study is well recognized as a successful model of integration of public and private efforts to use market forces, the media, and consumer education to improve dietary patterns.[97]

## CONCLUSIONS

This chapter has summarized current global trends in child survival and health, emphasizing their close links with nutritional status. In spite of the overall positive trends in child survival, child mortality is still unacceptably high in many parts of the world, and the gap between the lower and higher mortality countries has widened substantially over the past decade. In 2000, world leaders agreed on the Millennium Development Goals, which calls for halving the prevalence of child mortality by 2015. Projections from current data indicate that many developing countries will not reach that target until 2030 and beyond. This means that by 2015, still 8.7 million children will die before age 5.

To the challenge of undernutrition is now added the burden of chronic, noncommunicable diseases that are increasing at alarming rate in countries of intermediate development. Confronting this chronic disease epidemic will pose an enormous burden on the health case system. In spite of these challenges, the success of several programs aimed at reducing malnutrition, controlling micronutrient deficiencies, improving food security, and expanding immunization coverage is encouraging. Community involvement, empowerment of women, recognition of unique local social, cultural, and economic conditions, all seem to be key ingredients for success.

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