

# Child stunting in developing countries

Stunting and wasting in children are measures reflecting states of chronic and acute undernutrition that have important adverse effects on survival, health, and development. In impoverished settings, poor-quality diets and high rates of infection, both in pregnancy and in the first 2 years of life, lead to fetal growth restriction (FGR) and poor child growth. This results in an estimated 26% of the world's children younger than 5 years having stunted stature, and 8% being much too thin for their height (i.e. wasted) (UNICEF-WHO-The World Bank, 2012). Proven interventions to prevent the FGR that contributes to stunting include multiple vitamin and mineral supplements and provision of balanced energy/protein supplements to pregnant women, as well as control of maternal infections. After birth,

the most effective intervention is the supply of foods with adequate nutritional quality to complement breastfeeding in the first 2 years of life.

The physical growth of children within a normative range has important implications both within that age span and into adulthood (Bhutta et al., 2013). Insufficient gains in length/height and weight from birth to age 5 years, resulting from childhood undernutrition, put the child at increased risk of morbidity and mortality from infectious diseases as well as impaired mental development, reduced learning capacity in school, and lower earning potential as an adult, among other effects (Victora et al., 2008; Adair et al., 2013; Bhutta et al., 2013). As noted, childhood undernutrition is usually defined by physical size. Measures of length/height and weight are most common, although

there are others such as head circumference and mid-upper arm circumference that are commonly used in surveillance for severe acute malnutrition.

Length (recumbent, for age < 2 years) or height (standing, for age 2–4 years) or weight is compared to an international growth standard (WHO Multicentre Growth Reference Study Group, 2006), and the result is most commonly expressed as a Z-score (standard deviation score). The Z-score is the observed value for length/height or weight minus the median value of the growth standard, with this result divided by the standard deviation of the growth standard. If the Z-score for length/height-for-age is below -2, the child is considered to have inadequate linear growth or to be stunted. If the Z-score for weight-for-age is below -2, the child is said

to be underweight. The weight and length/height measures can be used together to create an indicator of wasting: a child whose Z-score for weight-for-length/height is below  $-2$  is considered to be wasted.

### Prevalence of child malnutrition

The latest UNICEF-WHO-The World Bank joint child malnutrition estimates provide global and regional prevalences for stunting and wasting based primarily on population-based, nationally representative surveys, with modelling to make regional estimates (UNICEF-WHO-The World Bank, 2012). The global prevalence of stunting in children younger than 5 years was estimated to be 26% (95% confidence interval [CI], 24–28%) for 2011, the most recent data. The number of stunted children in that year was estimated to be 165 million. The prevalence of stunting has declined from 40% in

1990, with an average annual rate of reduction of 2.1%. The prevalence of stunting varies substantially by world region (Fig. 2.1), with the highest prevalence in Africa and South-Central Asia (which includes India). The decline in the prevalence of stunting has been greater for Asia and Latin America than for Africa, which is the only region that has had an increasing number of stunted children, due to the slow declines in the prevalence and the high fertility rate (Fig. 2.2) (UNICEF-WHO-The World Bank, 2012; Bhutta et al., 2013).

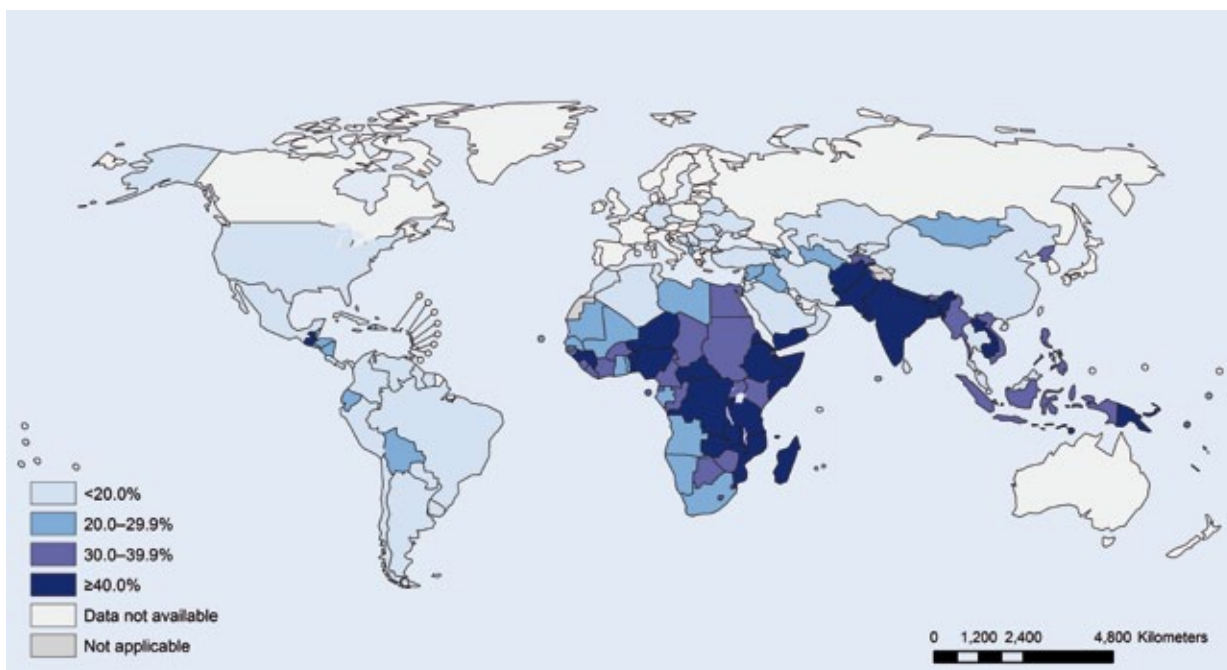
In countries with an overall prevalence of stunting greater than 10%, there is a gap – in some cases very wide – between the high prevalence in the poorest 20% and the low prevalence in the least poor 20% of the population. This illustrates the relationship of stunting and other forms of undernutrition with poverty and the associated problems of food insecurity and environmental exposure

to infectious agents and toxins. The global prevalence of moderate or severe wasting was estimated to be 8.0% (95% CI, 6.8–9.3%) for 2011. Again, there is regional variation in the prevalence (Fig. 2.3), with the highest prevalence in South-Central Asia (14.8%; 95% CI, 11.1–19.4%), South-East Asia (9.7%; 95% CI, 7.5–12.6%), and Africa (8.5%; 95% CI, 7.4–9.6%). The numbers of children with wasting and severe wasting were estimated to be 52 million and 19 million, respectively, for 2011. Recent estimates indicate that nearly 2 million deaths in children worldwide can be attributed to FGR and stunting, or a third of all child deaths (UNICEF-WHO-The World Bank, 2012; Bhutta et al., 2013).

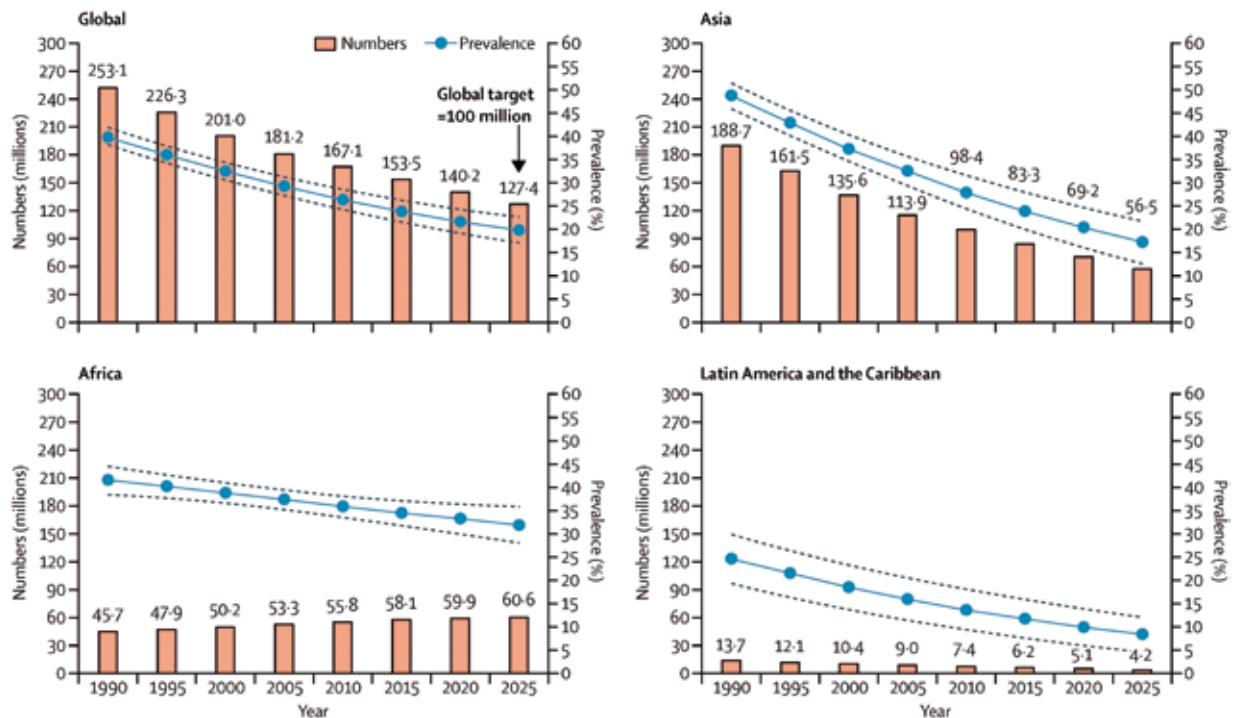
### Risk factors for child malnutrition

Preventable causes of FGR in utero and reduced growth of the child during the first 2 years of life include low

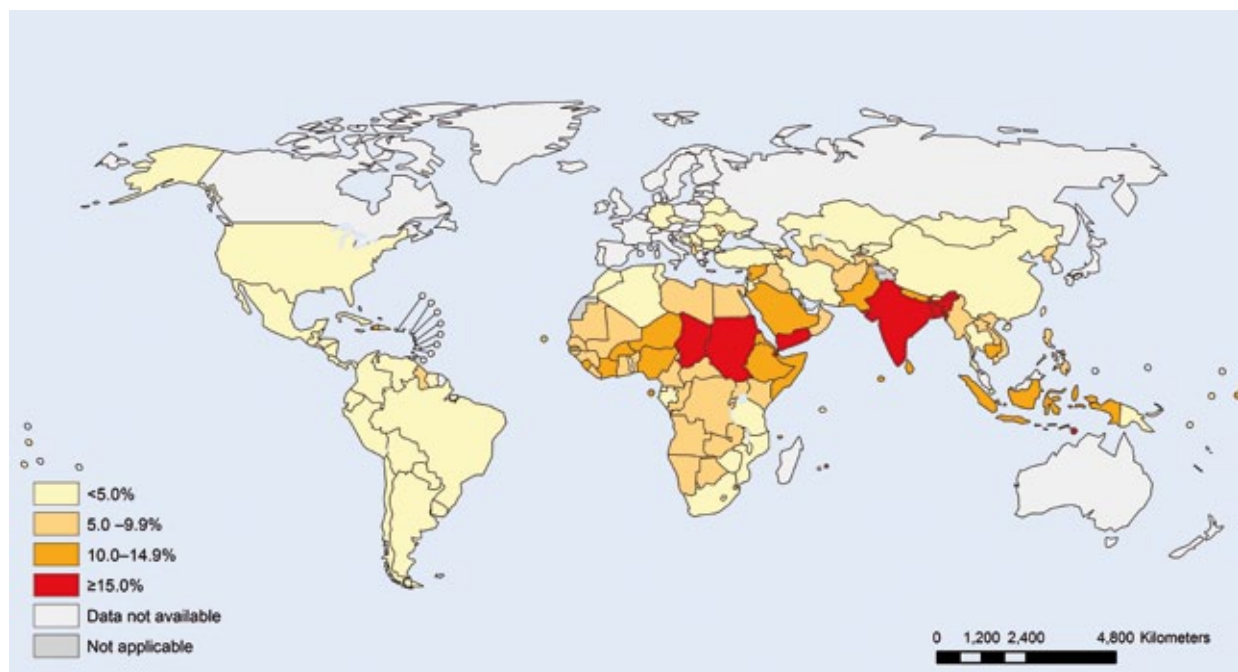
**Fig. 2.1.** Latest country prevalence estimates for stunting among children younger than 5 years. Source: Reprinted from UNICEF-WHO-The World Bank (2012), p. 9, © 2012, with the permission of the publisher.



**Fig. 2.2.** Trends in prevalence and numbers of children with stunted growth (height-for-age Z-score < -2), by selected United Nations regions and globally, 1990–2010, and projected to 2025 on the basis of United Nations prevalence estimates. Source: Reprinted from Black et al. (2013), © 2013, with permission from Elsevier. Data from UNICEF-WHO-The World Bank (2012).



**Fig. 2.3.** Latest country prevalence estimates for wasting among children younger than 5 years. Source: Reprinted from UNICEF-WHO-The World Bank (2012), p. 10, © 2012, with the permission of the publisher.



body mass index, small weight gain and micronutrient deficiencies during pregnancy, and maternal infections (Bhutta et al., 2013; Christian et al., 2013). It has been estimated that 27% of all births in low- and middle-income countries have FGR, with the highest prevalence in Asia, especially South Asia (Bhutta et al., 2013; Lee et al., 2013). Nutritional status at birth is related to the risk of being stunted at age 2 years. Globally, it has been estimated that 20% of stunting can be attributed to FGR. In some countries the attributable fraction is even higher. In India, where nearly half of all births have FGR, the attributable fraction for stunting is more than a third (Christian et al., 2013).

Most of the growth faltering leading to stunting occurs between ages 3 months and 18–24 months (Victora et al., 2010), a period of vulnerability because often insufficient and poor-quality food is provided to the child. Exclusive breastfeeding is recommended for the first 6 months of life but is uncommonly practiced; globally, only about 30% of infants aged 1–5 months are exclusively breastfed (Bhutta et al., 2013). The early introduction of fluids will reduce the production and ingestion of breast milk and substitute foods of lesser nutritional quality that also have a high risk of microbial contamination. In most of the affected regions, more than 60% of children aged 6–23 months are breastfed (Bhutta et al., 2013). However, the complementary foods that are introduced too often have inadequate nutrient density, calories, protein, essential fats, and micronutrients, and may contain infectious bacteria and/or toxins. Deficiency of the micronutrient zinc has been consistently associated with stunting, and increased linear growth in infants has been demonstrated with provision of daily zinc supplements (Bhutta et al., 2013).

High rates of diarrhoea and other infectious diseases also affect this age group, even with continued breastfeeding as complementary foods are introduced. In a pooled analysis of nine community-based studies in low-income countries, the odds of stunting at age 24 months increased multiplicatively with each episode of diarrhoea or day of diarrhoea before that age. The proportion of stunting attributed to five previous episodes of diarrhoea was 25% (95% CI, 8–38%) (Checkley et al., 2008). In addition to the clinical infections, frequent exposure to contaminated food and water and the household environment results in ingestion of microbes, causing sub-clinical infections that damage the small intestine. It has been hypothesized that environmental enteric dysfunction (EED) or environmental enteropathy, a condition characterized by structural abnormalities of the intestinal epithelium, altered barrier integrity, mucosal inflammation, and reduced nutrient absorption, may contribute to growth faltering and stunting (Keusch et al., 2013). It has also been hypothesized that zinc deficiency may be involved in the pathogenesis of EED (Lindenmayer et al., 2014). As noted by Lunn (2000) and discussed later in this Report, there is a potential role for ingested mycotoxins to contribute to EED or to other mechanisms that lead to stunting.

### **Interventions against child malnutrition**

Although breastfeeding, as recommended for the first 2 years of life, is important for the babies' health and dietary intake, the major interventions to prevent stunting are related to the foods that are given in addition to breast milk from age 6–23 months (i.e. complementary diet). Education about age-appropriate quantity

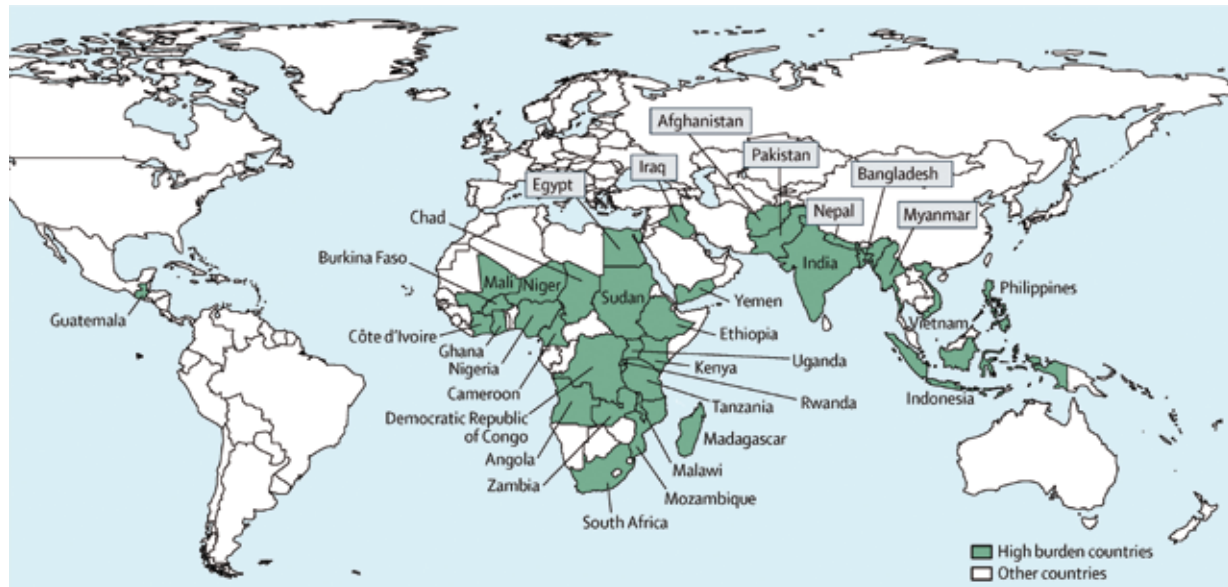
and quality of diets and provision of safe food supplements containing adequate micronutrients have been shown to improve growth and reduce the prevalence of stunting. Full (90% coverage) implementation of these interventions would reduce stunting by at least 20% in the 34 countries that include 90% of the world's stunted children (Fig. 2.4). These interventions would also be useful to prevent wasting (Bhutta et al., 2013). In stable non-emergency situations, wasting usually coexists with stunting after age 6–9 months. However, severe acute malnutrition (i.e. severe wasting) can occur more abruptly even in a previously well-nourished child due to food scarcity, such as in famine, natural disaster, or civil conflict. These are situations where targeted food distribution programmes are needed.

There is limited evidence that interventions in sectors other than health and nutrition may have a beneficial impact on stunting. These areas include efforts to improve agricultural productivity and improvements in water, sanitation, and hygiene, because of their potential to reduce the rates of diarrhoea and possibly the occurrence of EED (Dangour et al., 2013; Spears, 2013). Food safety interventions would be expected to positively influence nutrition and growth in young children by eliminating infectious agents that cause diarrhoea through foodborne transmission and possibly through avoidance of exposure to chemicals and mycotoxins.

### **Key scientific gaps and research needs**

Recent publications indicate that FGR is a more important contributor to neonatal and infant mortality (Katz et al., 2013) and to stunted linear growth (Christian et al., 2013) than previously recognized.

**Fig. 2.4.** Countries with the highest burden of malnutrition. These 34 countries account for 90% of the global burden of malnutrition. Source: Reprinted from Bhutta et al. (2013), © 2013, with permission from Elsevier.



This makes it imperative to look more closely at the causes of FGR and possible interventions to reduce it or ameliorate its negative effects. Maternal undernutrition and infection, as well as other possible determinants of FGR, need additional study, especially to identify feasible interventions to reduce its occurrence. If programmes intend to increase the provision of balanced energy/protein supplements during pregnancy, there are questions about the composition of supplements (preferably using locally available and safe foods) and their timing in pregnancy, how best to target the food supplements to vulnerable populations and undernourished or food-insecure women, how to achieve sufficient consumption, and ultimately the cost-effectiveness of alternative ways to deliver this intervention.

In spite of the known benefits of iron and folic acid supplementation in pregnancy, the current use of this intervention is low. Supplementation

with multiple micronutrients in pregnancy, instead of only iron and folic acid, would provide added benefits at modest additional cost. If multiple micronutrients are to be provided to pregnant women or to children, further product development research, linked with studies of the prevalence and extent of micronutrient deficiencies in various low-income populations, is needed. This will ensure that the composition is optimized to meet nutritional needs, reduce nutrient interactions, avoid side-effects, enhance acceptability, and reduce costs.

Most stunting of linear growth takes place in the first 2 years of life. The relative contributions to stunting of dietary insufficiency, infectious diseases or subclinical infections, and inflammation are unknown and may vary, as does the prevalence of stunting, by setting in low- and middle-income countries. There is good evidence that promotion of nutritious complementary foods or provision of food supple-

ments improves growth and reduces the occurrence of stunting; however, the effect size relative to the height deficit is small. Zinc supplements for children in the first 2 years of life also have a statistically significant, but small, benefit in reducing stunting. The *Lancet* nutrition series estimated that the nutrition-specific interventions together, if scaled up to 90%, would reduce the prevalence of stunting by only about 20% (Bhutta et al., 2013), illustrating the large gap in our knowledge of how to prevent stunting. Additional studies of the determinants of stunted growth need to include the possible role of subclinical infections and exposure to potentially harmful agents such as mycotoxins.

The first 2 years of life are a crucial period for both development and growth, which need to be considered separately as well as jointly. Young children in impoverished households lack both the stimulation needed for cognitive and psychosocial development and the

food and environmental conditions needed to promote physical growth and prevent illness.

In conclusion, stunting and wasting are nutritional conditions that most commonly affect children in low- and middle-income countries and have

serious consequences for survival, health, and development. Implementation of proven interventions to prevent their occurrence and to provide treatment must be given greater priority. Parallel efforts should address the evidence gaps through better un-

derstanding of the behavioural and biological determinants of stunting and wasting, including the possible role of mycotoxins, and the effectiveness of other nutrition-specific interventions and nutrition-sensitive approaches.