Chapter 12

Infant and Young Child Growth

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INTRODUCTION

Each year, undernutrition—including fetal growth restriction, stunting, wasting, and micronutrient deficiencies—and suboptimum breastfeeding (BF) underlie nearly 3.1 million deaths of children younger than age five years worldwide, accounting for 45 percent of all deaths in this age group (Liu and others 2012). Fetal growth restriction and suboptimum BF together are responsible for more than 1.3 million deaths, or 19.4 percent of all deaths among children younger than age five years.

Although the prevalence of stunted children has decreased from 40 percent in 1990 to 26 percent in 2011, an estimated 165 million children younger than age five years globally are stunted, based on the World Health Organization's (WHO's) Child Growth Standards (map 12.1). South Asia and Sub-Saharan Africa have the highest estimated prevalence; 68.0 million and 55.8 million stunted children live in South Asia and Sub-Saharan Africa, respectively (UNICEF, WHO, and World Bank 2012). Stunting prevalence among children younger than age five years is substantially higher in the poorest population quintiles and in rural areas, compared with the richest quintiles and urban areas, respectively (Black and others 2013). The complex interplay of social, economic, and political determinants of undernutrition results in substantial inequalities among population subgroups (Black and others 2013).

Optimum nutrition during the crucial periods of pregnancy and the first two years of life, known as the 1,000 days window of opportunity, is essential to health and growth, and its benefits can extend throughout life. A major component of infant and young child feeding (IYCF) in the early years of life is the provision of breast milk and appropriate, nutrient-dense complementary foods (PAHO and WHO 2003). In 2003, the WHO and the United Nations Children's Fund (UNICEF) published a jointly developed global strategy for IYCF to refocus attention on the impact that feeding practices have on infant nutrition and health (WHO and UNICEF 2003). In 2008, the WHO published a set of population-level IYCF indicators developed in response to the need for simple, practical indicators of appropriate feeding practices in children ages 6–23 months (WHO 2002; WHO and UNICEF 2008). A core set of eight indicators (three for BF and five for complementary feeding [CF]) includes measures of dietary diversity, feeding frequency, and consumption of iron-rich or iron-fortified foods, as well as indicators of appropriate BF practices (table 12.1) (Jones and others 2014).

This chapter discusses key concepts in nutrition and growth during this early phase of life, intrauterine growth and maternal interventions (balanced energy and micronutrient supplementation), nutrition interventions to improve infant and child feeding

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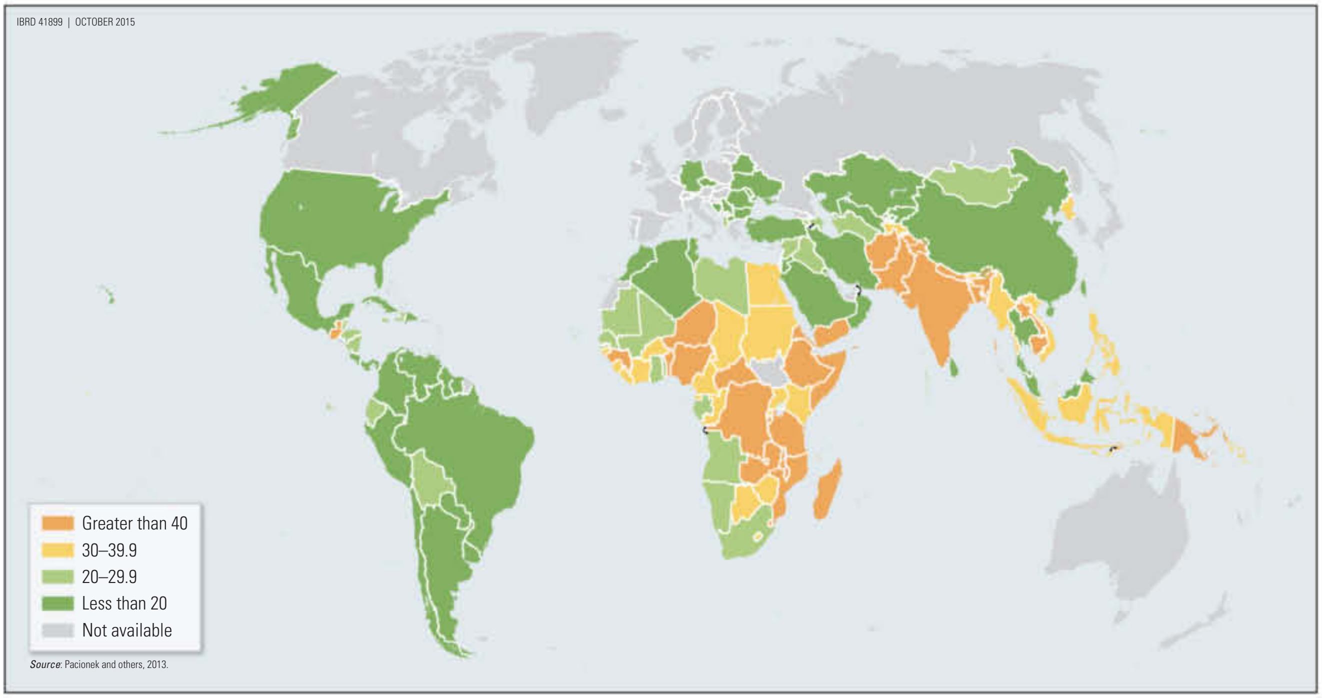
Map 12.1 Global Stunting Prevalence Estimates among Children Younger than Age Five Years



Source: UNICEF, WHO, and World Bank 2012.

Table 12.1 World Health Organization's Infant and Young Child Feeding Core Indicators

Breastfeeding indicators	
• Early initiation of breastfeeding	Proportion of children born in the past 24 months who were breastfed within one hour of birth
• Exclusive breastfeeding under age six months	Proportion of infants from birth to age five months who were exclusively breastfed during the previous day
• Continued breastfeeding at age one year	Proportion of children ages 12–15 months who were fed any breast milk during the previous day
Complementary feeding indicators	
• Introduction of solid, semisolid, or soft foods	Proportion of infants ages six months to eight months who received solid, semisolid, or soft foods during the previous day
• Minimum dietary diversity	Proportion of children ages 6–23 months who received foods from four or more food groups during the previous day
• Minimum meal frequency	Proportion of breastfed and nonbreastfed children ages 6–23 months who received solid, semisolid, or soft foods (including milk feeds for nonbreastfed children) the minimum number of times or more during the previous day
• Minimum acceptable diet	Proportion of children ages 6–23 months who had at least the minimum dietary diversity and minimum meal frequency (apart from breast milk) during the previous day
• Consumption of iron-rich or iron-fortified foods	Proportion of children ages 6–23 months who received iron-rich food or iron-fortified food specially designed for infants and young children, or fortified in the home, during the previous day

Source: Jones and others 2014.

(BF, CF, and micronutrient supplementation), other nutrition-related interventions, and challenges in infant and child feeding.

CONSEQUENCES OF UNDERNUTRITION

Good nutrition early in life is essential for children to be able to attain their full developmental potential. Malnutrition leads to early physical growth failure; delayed motor, cognitive, and behavioral development; diminished immunity; and increased morbidity and mortality (Black and others 2013). Deficiencies of essential vitamins and minerals are widespread and have substantial adverse effects on child survival and development. Deficiencies of vitamin A and zinc adversely affect child health and survival; deficiencies of iodine and iron can, together with causing stunting, limit the ability of children to realize their developmental potential.

Mortality and Morbidity

Black and others (2013) demonstrate that all degrees of stunting, wasting, and underweight are associated with increased hazards of death from diarrhea, pneumonia, measles, and other infectious diseases, with the exception of malaria; this analysis confirms the complex interplay between undernutrition and infection. In addition to anthropometric measures, the association between micronutrient deficiencies, such as vitamin A deficiency, and the increased risk of childhood infections and mortality is well established (Black and others 2013). Vitamin A deficiency increases the risk of severe diarrhea and diarrhea mortality, but it is not an important risk factor for the incidence of diarrhea or pneumonia or for pneumonia-related mortality. Other micronutrient deficiencies, such as zinc and iron deficiencies, are widespread in low- and middle-income countries (LMICs). Zinc is associated with increased risk of morbidity and mortality (Black 2003).

Growth and Development

Undernutrition has important consequences for physical and cognitive growth and development. Malnutrition leads to early physical growth failure; delayed motor, cognitive, and behavioral development; diminished immunity; and increased morbidity and mortality. Those who survive the initial and direct consequences of malnutrition in early childhood grow to adulthood, but with disadvantages compared with those who have had adequate nutrition and enjoyed a healthy environment in the initial crucial years of life. Undernutrition is strongly associated with shorter adult height, less schooling, and reduced economic productivity; in women, it is associated with offspring with lower birth weights. Fetal growth restriction, lower birth weight, and undernutrition in childhood have also been associated with long-term consequences, including increased risk of developing metabolic syndrome and cardiovascular disease, systolic hypertension, obesity, insulin resistance, and diabetes type II in adulthood (Greer, Sicherer, and Burks 2008; Salam, Das, and Bhutta 2014). The later consequences of childhood malnutrition also include diminished intellectual performance, low work capacity, and increased risk of delivery complications (Waddington and others 2009).

MATERNAL NUTRITION AND FETAL GROWTH

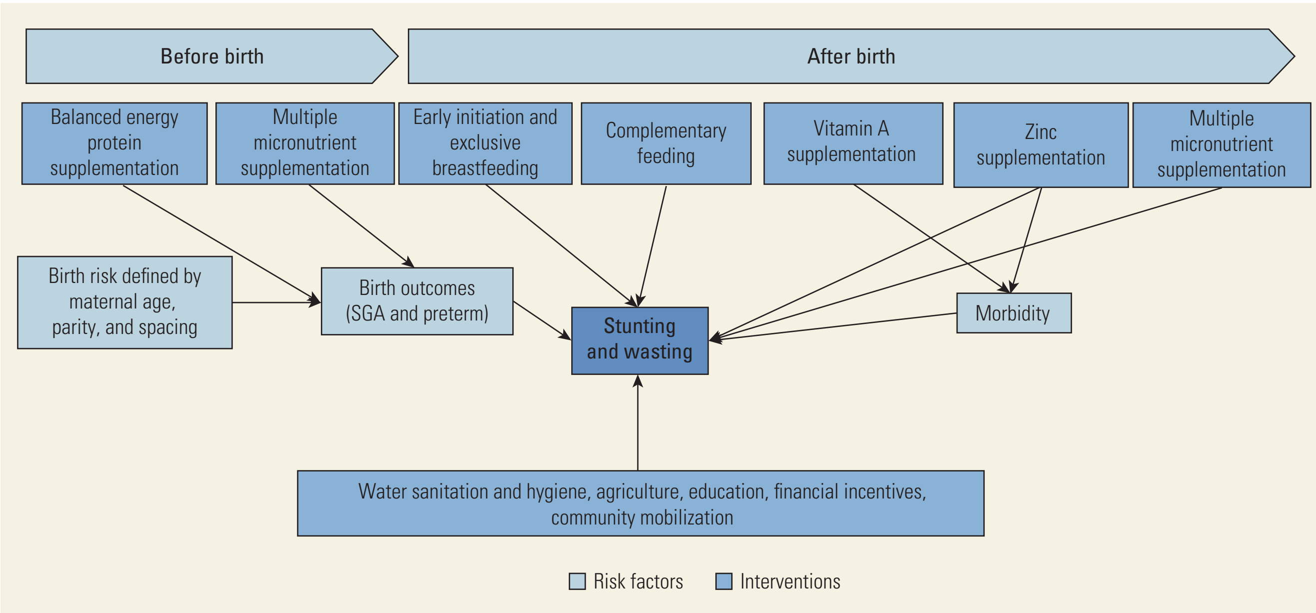
The determination of child nutrition status starts before birth; maternal nutritional status and fetal growth restriction have been found to be closely associated with child health. Maternal stunting and underweight lead to small for gestational age (SGA) and prematurity. Fetal growth restriction, in turn, is an important contributor to stunting and wasting in children; approximately 20 percent of childhood stunting could have its origins in the fetal period (Black and others 2013). Undernutrition can only be tackled through a multipronged approach with involvement of relevant sectors other than health. This approach was highlighted in the undernutrition series in *The Lancet* (Black and others 2013). The series underscores that nutrition-specific interventions can only reduce the current burden of undernutrition by a fraction; a more holistic approach is required that involves relevant sectors, including agriculture and food security, social safety nets, early child development, maternal mental health, women's empowerment, child protection, classroom education, water and sanitation, and health and family planning services. The conceptual framework in figure 12.1 highlights the risk factors and the nutrition-specific interventions for childhood stunting and wasting.

Definitions

Intrauterine growth restriction (IUGR) describes the pathological inhibition of fetal growth. Although there is no standard definition of IUGR, two terms have been used to describe it: *SGA* and *low birth weight* (LBW):

- *SGA*, the most commonly used term for IUGR, is defined as babies born with weight of less than the 10th percentile of recommended gender-specific weight for gestational age for that population (WHO 1995; Yakoob and Bhutta 2011).
- *LBW* is defined as birth weight less than 2,500 grams, irrespective of gestational age.

Figure 12.1 Malnutrition Risk Factors and Nutrition-Specific Interventions



Note: SGA = small for gestational age.

Because birth size depends on both gestational age and growth velocity, the term *SGA* is preferred to LBW. A baby born with LBW but appropriate for gestational age is expected to have better outcomes compared with a baby born SGA. However, LBW has been the most commonly used indicator to describe fetal growth because it can be difficult to determine true gestational age in LMICs (WHO 1995). In this chapter, SGA is used as a proxy indicator for IUGR.

Causes of Intrauterine Growth Restriction

IUGR can have multiple causes. Some of the known risk factors include maternal malnutrition, congenital malformations, congenital infections, maternal smoking, and maternal medical comorbidities such as primary hypertension and diabetes mellitus (Romo, Carceller, and Tobajas 2009). In LMICs, maternal malnutrition is an important risk factor for SGA babies; however, in high-income countries (HICs), cigarette smoking is the most important single factor implicated in IUGR, followed by poor gestational nutrition (Bhutta and others 2013; Salam, Das, and Bhutta 2014). The major nongenetic factor determining the size of the fetus at term is maternal constraint, which is a set of maternal and uteroplacental factors that act to limit the growth of the fetus by limiting nutrient availability or the metabolic-hormonal drive to grow; these factors are more pronounced in pregnancies involving young mothers, small maternal size, nulliparous, and multiple pregnancies (Gluckman and Hanson 2004). Maternal nutrition influences the availability of nutrients for transfer to the fetus; during starvation, it is likely that low food intake results in a reduced nutrient stream from mother to fetus, giving rise to fetal growth restriction. Maternal undernutrition (body mass index of less than 18.5 kilograms/square meter) has decreased overall since 1980 but remains greater than 10 percent in South Asia and Sub-Saharan Africa (Black and others 2013).

Consequences of Intrauterine Growth Restriction

IUGR is associated with a higher risk of preterm delivery and higher rates of fetal and neonatal morbidity and mortality (Arcangeli and others 2012; Baschat 2011). This higher rate of neonatal mortality in IUGR infants is due to conditions that include birth asphyxia and infections (such as sepsis, pneumonia, and diarrhea), which lead to mortality and together account for about 60 percent of all neonatal deaths (Salam, Das, and Bhutta 2014).

The short-term consequences of IUGR involve metabolic and hematological disturbances, as well as disrupted thermoregulation, which lead to morbidities such as respiratory distress syndrome, necrotizing enterocolitis, and retinopathy of prematurity (Salam, Das, and Bhutta 2014). The adverse consequences of IUGR are not limited to infancy and childhood; they extend throughout the lifespan. IUGR leads to stunting and wasting, and an estimated 20 percent of stunted children in LMICs were born SGA (Black and others 2013). Evidence indicates that adverse changes in the fetal nutritional environment are associated with increased risk of developing metabolic syndrome and cardiovascular disease, systolic hypertension, obesity, insulin resistance, diabetes type II, and neuropsychological and cognitive deficiencies, as well as with impairments in renal and lung development in adulthood (Bjarnegard and others 2013; Salam, Das, and Bhutta 2014). It has also been shown that early developmental conditions affect all children and their predispositions to long-term consequences, including noncommunicable diseases (Hanson and Gluckman 2011).

Prevention of Intrauterine Growth Restriction

No effective therapies exist to reverse IUGR. Accordingly, initiatives focus on prevention through optimizing the nutritional status of women at the time of conception to establish the foundation for healthy fetal growth and development. Pregnancy is a state of higher metabolic requirements, and both macronutrients and micronutrients play important roles. Multiple nutrition interventions to address maternal nutritional requirements have been studied. These include nutritional counseling; isocaloric (maternal nutrition supplement given during pregnancy in which protein provides 25 percent of total energy content), high (protein provides more than 25 percent of total energy content), and balanced protein energy (BEP) (protein provides less than 25 percent of total energy content) supplementation; micronutrient supplementation; and low-energy supplementation for obese women.

Of these interventions, only BEP supplementation has been shown to affect the incidence of SGA (Bhutta and others 2013). A meta-analysis of 16 studies shows that BEP supplementation increased birth weight (mean difference [MD]: 73 grams; 95 percent confidence interval [CI]: 30–117) and decreased the incidence of SGA (relative risk [RR]: 0.66; 95 percent CI: 0.49–0.89); these effects were more pronounced in malnourished women compared with adequately nourished women. BEP supplementation also decreased the risk of stillbirth; however, the number of patients included in the meta-analysis was small (Imdad and Bhutta 2012).

Micronutrient supplementation during pregnancy has been studied with regard to individual and multiple micronutrients and their beneficial effects for mothers and the developing fetuses. Calcium supplementation has been shown to reduce the incidence of preeclampsia in populations with low calcium intake. Folic acid supplementation during and before pregnancy reduces the incidence of neural tube defects (Bhutta and others 2013). Among micronutrient interventions, iron or iron and folate supplementation has been shown to reduce the incidence of LBW and improve birth weight but has no impact on SGA or IUGR (Peña-Rosas and others 2012; Peña-Rosas and Viteri 2009). Multiple micronutrient supplementation, when compared with iron and folate supplementation, has reduced the incidence of SGA babies by 13 percent (Haider and Bhutta 2012). The effects of supplementation in reducing the incidence of IUGR are clear; moreover, these benefits may extend into early childhood and affect growth and development. The effects of supplementation are not only apparent in reduced IUGR but also in its possible translation into early childhood development (Vaidya and others 2008).

BREASTFEEDING

Timing

The exact scientific basis for the absolute early time window of feeding within the first hour after birth is weak (Edmond and others 2006; Mullany and others 2008). A systematic review suggests that BF initiation within 24 hours of birth is associated with a 44 percent to 45 percent reduction in all-cause and infection-related neonatal mortality and is thought to primarily operate through the effects of exclusive breastfeeding (EBF) (Debes and others 2013).

Interventions to promote BF are a key component of expanding its use. A review of the effects of promotion interventions on occurrence of BF concludes that counseling or educational interventions increased EBF by 43 percent at day one, by 30 percent until age one month, and by 90 percent from age one month to age five months. Significant reductions in the occurrence of mothers not BF were also noted; 32 percent reduction at day one, 30 percent until one month, and 18 percent for one month to five months (Haroon and others 2013). Combined individual and group counseling seemed to be better than individual or group counseling alone.

Prevalence of Breastfeeding

BF provides numerous immunologic, psychological, social, economic, and environmental benefits. It results in improved infant and maternal health outcomes in both LMICs and HICs (Eidelman and others 2012). The WHO recommends EBF for infants until age six months to achieve optimum growth (Kramer and Kikuma 2001). In LMICs, one out of every three children is exclusively breastfed for the first six months of life, although considerable variations exist across regions (UNICEF 2006). Recent data show that the prevalence of EBF in LMICs has increased from 33 percent in 1995 to 39 percent in 2010 (Cai, Wardlaw, and Brown 2012). The prevalence of EBF increased in almost all regions in LMICs, with a major improvement seen in central and west Africa, where the prevalence more than doubled from 12 percent to 28 percent. More modest improvements were observed in South Asia, where the prevalence increased from 40 percent in 1995 to 45 percent in 2010. The median coverage of EBF has increased from 26 percent in 2000–05 to 40 percent in 2006–11 in the 48 Countdown countries (countries with the highest burden of maternal and child deaths) (WHO and UNICEF 2012).

EBF reduces the risk of hospitalization for lower respiratory tract infections in the first year by 72 percent (Ip and others 2007; Ip and others 2009). Any BF compared with exclusive commercial infant formula feeding can reduce the incidence of otitis media by 23 percent, and EBF for more than three months reduces the risk of otitis media by 50 percent (Ip and others 2007). Any BF is associated with a 64 percent reduction in the incidence of nonspecific gastrointestinal tract infections; this effect lasts for two months after cessation of BF (Ip and others 2007; Duijts and others 2010; Ip and others 2009; Quigley, Kelly, and Sacker 2007). BF is also beneficial for preterm infants; it is associated with a 58 percent reduction in the incidence of necrotizing enterocolitis (Ip and others 2007). EBF offers a protective effect for three to four months against the incidence of clinical asthma, atopic dermatitis, and eczema by 27 percent in a low-risk population and up to 42 percent in infants with positive family history (Ip and others 2007; Greer, Sicherer, and Burks 2008). BF can improve nutrition status directly or by reducing infections and morbidity. Promoting EBF is reported to be important in preventing both stunting and overweight among children (Keino and others 2014). A systematic review shows that breastfeeding up to two years of age or beyond had no significant impact on child growth; however, further research is needed (Delgado and Matijasevich 2013).

Supportive Strategies

Although these results show the potential for scaling up BF, none of these trials addresses the issues of barriers in work environments and supportive strategies to overcome them, such as provisions for maternity leave. A Cochrane review of interventions in the workplace to support BF for women found no trials (Abdulwadud and Snow 2012), so much more needs to be done to assess innovations and strategies to promote BF in working women, especially in low-income communities.

COMPLEMENTARY FEEDING

CF for infants refers to the timely introduction of safe and nutritional foods in addition to BF, specifically, clean and nutrient-dense additional foods introduced at age six months and typically provided until age 24 months (Imdad, Yakoob, and Bhutta 2011; WHO 2002). It has been suggested that in addition to disease-prevention strategies, CF interventions targeting this critical window are most efficient in reducing malnutrition and promoting adequate growth and development (WHO 2002).

According to the WHO, CF should be timely, adequate, appropriate, and given in sufficient quantity (WHO 2002). Several strategies have been used to improve CF practices (Dewey and Adu-Afarwuah 2008). These include providing nutritional counseling for mothers to promote healthy feeding practices; providing complementary foods offering extra energy, with or without micronutrient fortification; and increasing the nutrient density of complementary foods through simple technology (Dewey and Adu-Afarwuah 2008).

Inadequacy and insufficiency of complementary foods, poor feeding practices, and high rates of infections have unfavorable impacts on health and growth among children. Sufficient quantities of adequate, safe, and appropriate CF after age six months are essential to meet nutritional requirements when breast milk alone is no longer sufficient. However, estimates indicate that in LMICs, only 39 percent of children younger than age six months were exclusively breastfed in 2010 (Cai, Wardlaw, and Brown 2012); only 58 percent of babies ages six months to nine months were breastfed and given complementary foods; and only 50 percent of babies ages 10 months to 23 months were provided with complementary food and continued BF (UNICEF 2013).

Several strategies have been used to improve CF practices. However, the diversity in types of food, duration, and interventions used makes it difficult to conclude that one particular type of CF intervention is the most effective (Dewey and Adu-Afarwuah 2008). A review (Lassi and others 2013) of two CF strategies—nutritional education and CF with or without nutritional education—shows a significant impact of CF education on height-for-age z-score (HAZ) (MD: 0.23; 95 percent CI: 0.09–0.36), weight-for-age z-score (WAZ)

(MD: 0.16; 95 percent CI: 0.05–0.27), and rates of stunting (RR: 0.71; 95 percent CI: 0.56–0.91). Impacts were even more dramatic when education on CF was provided in combination with actual complementary food in food-insecure populations (HAZ scores: RR: 0.39; 95 percent CI: 0.05–0.73).

Education for improved feeding practices is essential to improve maternal knowledge and to prepare culturally acceptable enriched complementary foods that can lead to increased dietary intake and growth of infants. Maternal counseling in health system and community settings is critical to safeguarding optimal CF practices. Educational messages should be clear and should include the promotion of nutrient-rich animal products. However, in food-insecure populations, these messages need to be combined with food provision or use of protein-rich plant food sources (Lassi and others 2013). Financial constraints may limit the possibility of including adequate amounts of animal products in children's diets, particularly among food-insecure populations (Lassi and others 2013). Measures should be taken at the community level to support activities involving community health workers, lay counselors, and mothers to build community or mother support groups. Communication and advocacy activities on CF could lay the foundation for improved growth and health.

MICRONUTRIENT SUPPLEMENTATION

Micronutrient Deficiencies

According to WHO global estimates, 190 million preschool children and 19.1 million pregnant women have vitamin A deficiencies, defined as serum retinol of less than 0.70 micromoles per liter (Bjarnegard and others 2013). Globally, an estimated 5.17 million preschool-age children (0.9 percent) have night blindness, and 90 million (33.3 percent) have subclinical vitamin A deficiencies (WHO 2009). Approximately 100 million women of reproductive age have iodine deficiencies, and an estimated 82 percent of pregnant women worldwide have inadequate zinc intakes to meet the normal needs of pregnancy (WHO and UNICEF 2003). Iron deficiencies are widespread; about 1.62 billion people have anemia (de Benoist and others 2008); 18.1 percent and 1.5 percent of children have anemia and severe anemia, respectively (Salam, Das, and others 2013). South Asia and Sub-Saharan Africa have the highest prevalence of all iron deficiency anemia, and Sub-Saharan Africa has the highest prevalence of severe iron deficiency anemia (Black and others 2013). Suboptimal vitamin B6 and B12 statuses have also been observed in many LMICs (McLean, de Benoist, and Allen 2008).

Zinc

Zinc deficiency has been associated with growth failure and increased risk of morbidity and mortality due to diarrheal and respiratory illness (Black and others 2013). Multiple randomized trials have studied the role of preventive zinc supplementation to promote linear growth; the findings vary across the study populations (Brown and others 2009; Ramakrishnan, Nguyen, and Martorell 2009). Meta-analyses have shown an overall beneficial effect of zinc supplementation to promote linear growth (Brown and others 2009; Imdad and Bhutta 2011). This effect is more pronounced when zinc is supplemented alone compared with when it is administered in combination with iron (Imdad and Bhutta 2011). The effect is also more pronounced for children with baseline stunting (Umeta and others 2000). No standard dose and duration of zinc supplementation has been recommended to promote linear growth; however, combined data from multiple trials in one of the meta-analyses show that a dose of 10 milligrams per day for 24 weeks led to net gains of 0.37 centimeters (standard deviation ± 0.25) in the intervention group compared with the control (Imdad and Bhutta 2011). Therapeutic zinc given to children with diarrhea has also been shown to reduce the duration and severity of illness (Walker and Black 2010).

Vitamin A

Vitamin A deficiency, a risk factor for increased incidence of infections, is the most common nutritional cause of blindness in the world. It is well established that vitamin A supplementation during childhood decreases all-cause mortality and mortality due to diarrhea and measles (Imdad and others 2010). Studies have also evaluated its role in promotion of linear growth; results have shown that vitamin A supplementation does not have any significant role in this respect. A meta-analysis by Ramakrishnan, Nguyen, and Martorell (2009) analyzes data from 17 studies and finds no statistically significant effect of vitamin A on growth. A large randomized trial conducted in India also does not show any positive effect of vitamin A supplementation on height gain (Awasthi and others 2013).

Iron

The proportion of all childhood anemia corrected by iron supplementation ranges from 63 percent in Europe to 34 percent in Sub-Saharan Africa. A review of 33 studies shows that intermittent iron supplementation in children younger than age two years reduced the risk of anemia by 49 percent and iron deficiency by

76 percent (De-Regil and others 2011). The findings also suggest that intermittent iron supplementation could be a viable public health intervention in settings in which daily supplementation has not been implemented or is not feasible.

A review of the effect of iron supplementation in children on mental and motor development shows only small gains in the mental development and intelligence scores in supplemented school-age children who were initially anemic or iron deficient (Sachdev, Gera, and Nestel 2005). There is no convincing evidence that iron treatment has an effect on the mental development of children younger than age 27 months. Because it has been demonstrated that there is an increased risk of admission to hospital and serious illnesses with iron supplementation in malaria-endemic areas (Sazawal and others 2006), the WHO recommends administration of routine prophylactic iron supplements in malaria-endemic areas on the stipulation that malaria prevention and treatment are made available (WHO 2011, 2014).

Multiple Micronutrient Supplementation

In many LMICs, micronutrient deficiencies coexist, suggesting the need for simple approaches that evaluate and address multiple micronutrient supplementation. These approaches include education, dietary modification, food provision, agricultural interventions, supplementation, and fortification, either alone or in combination. Food fortification can be a potentially cost-effective public health intervention and target a larger population through a single strategy. A meta-analysis of multiple micronutrient fortification in children shows an increase in hemoglobin levels by 0.87 grams per deciliter (95 percent CI: 0.57–1.16) and 57 percent reduced risk of anemia (RR: 0.43; 95 percent CI: 0.26–0.71). Multiple micronutrient food fortification also increased vitamin A serum levels (retinol increase of 3.7 milligrams per deciliter; 95 percent CI: 1.3–6.1) (Eichler and others 2012).

In the past decade, point-of-use or home fortification of child diets has emerged to address widespread micronutrient deficiencies. Multiple micronutrient powders (MNPs) or sprinkles are powdered encapsulated vitamins and minerals that can be added to prepared foods with little change to the food's taste or texture. MNPs are designed to provide the recommended daily nutrient intake of two or more vitamins and minerals to their target populations. A review has established that MNPs appear to be effective for reducing anemia and iron deficiency in children younger than age two years (De-Regil and others 2013). Another review of MNPs suggests benefit in improving anemia and hemoglobin among children; however, it shows no impact on growth and evidence of increased diarrhea, suggesting further consideration is needed before large-scale implementation (Salam and others 2013).

NUTRITION-SENSITIVE INTERVENTIONS

Complementing the nutrition-specific interventions are nutrition-sensitive interventions to aid the implementation of these primary interventions. Although the direct impact of nutrition-sensitive interventions is limited, they have huge potential. These programs include the following:

- Water, sanitation, and hygiene (WASH) strategies
- Financial incentives at multiple levels
- Community-based nutrition education and mobilization programs.

These strategies can be delivered through health systems, agriculture-based programs, market-based approaches, or other community-based platforms.

WASH Strategies

Consensus has emerged on the importance of improved water supply and excreta disposal for prevention of diseases, especially diarrheal diseases. Provision of safe and clean water, as well as enhanced facilities for excreta disposal and promotion of hygiene, not only aim to improve the quality of life, but also help reduce the incidence of infectious diseases, particularly in children. In 2011, 89 percent of the world's population used improved drinking-water sources, and 55 percent had a piped supply on the premises. In the same year, 1 billion people still defecated in the open (WHO 2013). Although geographic disparities exist, rural and urban disparities within countries are also striking: 83 percent of the rural population has no access to safe water and 71 percent lives without sanitation (WHO 2013). Despite the declining open defecation rates globally, some countries, such as Cambodia and Benin, still have open defecation rates as high as 58 percent and 54 percent, respectively (WHO 2013). Ensuring safe WASH practices is urgently needed at household and community levels.

A review (Dangour and others 2013) of the effect of WASH interventions on the nutritional status of children younger than age 18 years finds no impact on WAZ scores (MD 0.05; 95 percent CI: −0.01–0.12) and weight-for-height z-score scores (MD: 0.02; 95 percent CI: −0.07–0.11), but a small impact on HAZ scores (MD 0.08; 95 percent CI 0.00–0.16). Another review (Cairncross and others 2010) highlights promising impacts of handwashing on reducing diarrhea morbidity by 47 percent (RR: 0.53; 95 percent CI: 0.37–0.67). Water quality improvement also showed significant impacts on reducing the incidence of diarrhea by 42 percent (RR 0.58; 95 percent CI: 0.46–0.72). Another review (Waddington and others 2009) of the effectiveness of these interventions concludes that interventions for water quality (protection or treatment of water at source or point of use) were more effective than interventions to improve water supply (improved source of water, improved distribution, or both). Interventions for water quality were associated with a 42 percent relative reduction in diarrhea morbidity in children younger than age five years, whereas those for water supply had no significant effects.

Overall, sanitation interventions led to a 37 percent reduction in childhood diarrhea morbidity, and hygiene interventions led to a 31 percent reduction. Subgroup analysis suggests that provision of soap with education was more effective than education only. The results suggest that interventions to improve the microbial quality of water, adequate excreta disposal, and behavior change interventions for promotion of hand washing and hygiene play their parts very efficiently in reducing the occurrence of infectious diseases and improving nutrition. Disease prevention and management interventions also have a role in improving nutrition, especially interventions targeting diarrhea and pneumonia (Bhutta and others 2013; Hutton and Chase, forthcoming).

Financial Incentives

Financial incentives are increasingly used as policy strategies to counter poverty, reduce financial barriers, and improve population health. A review of the effect of financial incentives on the coverage of health and nutrition interventions and behaviors targeting children younger than age five years (Bassani and others 2013) concludes that financial incentives have the potential to promote increased coverage of several important child health interventions. More pronounced effects seemed to be achieved by programs that directly removed user fees for access to health services. Some indication of effect was noted for programs that conditioned financial incentives on participation in health education and attendance at health care visits.

Community-Based Programs

A full spectrum of promotive, preventive, and curative interventions to improve child nutrition can be delivered via community platforms. A review (GHWA 2010) of community-based packages of care suggests that these interventions can double the rate of initiation of BF within one hour of birth (RR: 2.25; 95 percent CI: 1.70–2.97). Lewin and others (2010) review 82 studies with lay health workers and show moderate-quality evidence of the effect on the initiation of BF (RR: 1.36; 95 percent CI: 1.14–1.61), any BF (RR: 1.24; 95 percent CI: 1.10–1.39), and EBF (RR: 2.78; 95 percent CI: 1.74–4.44), compared with usual care.

Although much of the evidence from large-scale programs using community health workers is of poor quality, process indicators and assessments do suggest that community health workers are able to implement many of these projects at scale, and they have substantial potential to improve the uptake of child health and nutrition outcomes in difficult-to-reach populations (GHWA 2010). It is important to underscore the crucial importance of community engagement and buy-in to ensure effective community outreach programs, behavior change, and access (chapter 14 in this volume, [Lassi, Kumar, and Bhutta 2016]).

CHALLENGES AND THE WAY FORWARD

Existing Evidence

The nutrition series in *The Lancet* highlights the existing promising nutrition-specific interventions to reduce fetal growth restriction and SGA births and improve nutrition among children younger than age five years in LMICs (table 12.2) (Bhutta and others 2013). These interventions include the following:

- Periconceptional folic acid supplementation or fortification
- Maternal BEP
- Iron-folate supplementation
- Multiple micronutrient supplementation
- Calcium supplementation for preeclampsia
- BF promotion
- Appropriate CF
- Preventive zinc and vitamin A supplementation
- Management of malnutrition in children.

Scaling up these identified interventions to 90 percent coverage could reduce deaths among children younger than age five years by nearly 15 percent and could reduce stunting by 20 percent and severe wasting by 61 percent (figure 12.2) (Bhutta and others 2013).

Geographic Disparities

Despite the existence of proven interventions and relative improvements in nutrition indicators overall,

Table 12.2 Interventions to Improve Nutrition in Mothers and Children Younger than Age Five Years

Intervention	Estimates
Maternal interventions	
Iron or iron-folate supplementation	• LBW (RR: 0.80; 95 percent CI: 0.68–0.97) • Birth weight (MD: 30.81 g; 95 percent CI: 5.94–55.68) • Serum hemoglobin concentration at term (MD: 8.88 g/l; 95 percent CI: 6.96–10.80) • Anemia at term (RR: 0.31; 95 percent CI: 0.19–0.46) • Iron deficiency (RR: 0.43; 95 percent CI: 0.27–0.66) • Iron deficiency anemia (RR: 0.34; 95 percent CI: 0.16–0.69) • Side effects (RR: 2.36; 95 percent CI: 0.96–5.82) • Nonsignificant impacts on premature delivery, neonatal death, congenital anomalies
Maternal multiple micronutrient supplementation	• LBW (RR: 0.89; 95 percent CI: 0.83–0.94) • SGA (RR: 0.87; 95 percent CI: 0.81–0.95) • Nonsignificant impacts on preterm birth, miscarriage, maternal mortality, perinatal mortality, stillbirths, and neonatal mortality
Maternal balanced energy protein supplementation	• Risk of SGA reduced by 34 percent (RR: 0.66; 95 percent CI: 0.49–0.89) • Stillbirths reduced by 38 percent (RR: 0.62; 95 percent CI: 0.40–0.98) • Birth weight increased (MD: 73 g; 95 percent CI: 30–117)
Child interventions	
Breastfeeding	• Exclusive breastfeeding rates increased by 43 percent at four to six weeks, with 89 percent and 20 percent significant increases in LMICs and HICs, respectively. Exclusive breastfeeding improved at age six months by 137 percent, with a sixfold increase in LMICs.
Complementary and supplementary feeding	• Statistically significant difference of effect for length during the intervention in children
Iron supplementation	• Anemia (RR: 0.51; 95 percent CI: 0.37–0.72) • Iron deficiency (RR: 0.24; 95 percent CI: 0.06–0.91), hemoglobin (MD: 5.20 g/l; 95 percent CI: 2.51–7.88), ferritin (MD: 14.17 mcg/l; 95 percent CI: 3.53–24.81)
Vitamin A supplementation	• All-cause mortality reduced by 24 percent (RR: 0.76; 95 percent CI: 0.69–0.83) • Diarrhea-related mortality reduced by 28 percent (RR: 0.72; 95 percent CI: 0.57–0.91) • Incidence of diarrhea reduced by 15 percent (RR: 0.85; 95 percent CI: 0.82–0.87) • Incidence of measles reduced by 50 percent (RR = 0.50; 95 percent CI 0.37–0.67) • Nonsignificant impacts on measles and ARI-related mortality
Zinc supplementation	• Height improved by 0.37 centimeters (SD 0.25) in children supplemented for 24 weeks • Diarrhea reduced by 13 percent • Pneumonia reduced by 19 percent • Nonsignificant impacts on mortality
Disease prevention and management	
WASH interventions	• Diarrhea reduced by 48 percent (RR: 0.52; 95 percent CI: 0.34–0.65) with handwashing with soap, 17 percent with improved water quality, and 36 percent with excreta disposal
Deworming	• Prophylactic single and multiple dose deworming had a nonsignificant effect on hemoglobin and weight gain. • Treating children with proven infection showed that single dose of deworming drugs increases weight (0.58 kg; 95 percent CI: 0.40–0.76) and hemoglobin (0.37 g/dL; 95 percent CI: 0.1–0.64).

table continues next page

Table 12.2 Interventions to Improve Nutrition in Mothers and Children Younger than Age Five Years (continued)

Intervention	Estimates
Malaria prevention and treatment	• Antimalarials to prevent malaria in pregnant women reduced antenatal parasitemia (RR: 0.53; 95 percent CI: 0.33–0.86) • Birth weight increased (MD: 126.7 g; 95 percent CI: 88.64–164.75) • LBW and severe antenatal anemia reduced by 43 percent and 38 percent, respectively • ITNs in pregnancy reduced LBW by 23 percent (RR: 0.77; 95 percent CI: 0.61–0.98) and reduced fetal loss (first to fourth pregnancies) by 33 percent (RR: 0.67; 95 percent CI: 0.47–0.97) • Nonsignificant impacts on anemia and clinical malaria

Source: Bhutta and others 2013.
Note: ARI = acute respiratory infection; CI = confidence interval; g = grams; g/dL = grams per deciliter; g/l = grams per liter; HIC = high-income country; ITNs = insecticide treated bednets; kg = kilogram; LBW = low birth weight; LMICs = low- and middle-income countries; mcg/l = micrograms per liter; MD = mean difference; RR = relative risk; SD = standard deviation; SGA = small for gestational age; WASH = water, sanitation, and hygiene.

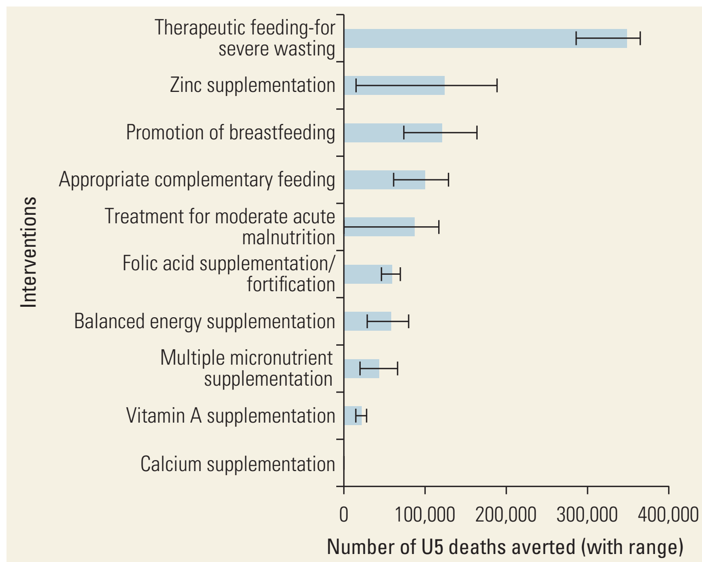
nutrition data indicate considerable disparities among geographic regions, with South Asia bearing the highest burden (Stevens and others 2012). Almost 75 percent of all the world's LBW infants are born in South Asia. In the 75 Countdown countries, more than one child in three is stunted, and the median prevalence of wasting is 7.1 percent. Within countries, wide disparities exist between the richest and poorest wealth quintiles; in 20 percent of the Countdown countries, more than 50 percent of the children in the poorest 20 percent of all families is stunted. With these existing disparities, another challenge is the human immunodeficiency virus epidemic in the Countdown countries, especially those in Sub-Saharan Africa, which threatens to reverse all the nutrition gains achieved through large-scale programs.

Way Forward

Optimal IYCF means that mothers receive optimal antenatal care, are empowered to initiate BF within one hour of birth, BF exclusively for the first six months, and continue BF for two years or more, complemented by nutritionally adequate, nutrient-dense, safe and age-appropriate feeding of solid, semisolid, and soft foods starting in the sixth month (UNICEF 2014). Despite the existing guidelines, early cessation of BF and untimely introduction and poor-quality CF prevail. Strategies to protect, promote, and support EBF are needed at the national, health systems and community levels.

- **At the national level**, creating appropriate structures that ensure the adoption and implementation of the proper policies and legislation is vital (UNICEF 2014). This approach includes the development and implementation of national IYCF policies and strategy frameworks, as well as the development and enforcement of legislation that relates to the International Code of Marketing of Breast-milk Substitutes and maternity protection.
- **At the health systems level**, strategies include implementation of the Baby-Friendly Hospital Initiative, the education of health staff about adherence to the International Code of Marketing of Breast-milk Substitutes, as well as capacity building for health workers in areas such as BF counseling (UNICEF 2014).
- **At the community level**, maternal support activities involving community health workers, lay counselors, and mother-to-mother support groups

Figure 12.2 Deaths Younger than Age Five Years Averted by the Scale-Up of Selected Nutrition Interventions per Year by 2025



Source: Bhutta and others 2013.
Note: U5 = under age five years.

are crucial. Promoting the importance of BF possibilities at the workplace is vital. Implementation of an evidence-based communication strategy using multiple channels, connecting and coordinating the efforts at the three levels, is also vital for the successful protection, promotion, and support of BF.

Appropriate CF is a proven intervention that can significantly reduce stunting during the first two years of life. An important issue is that the quality of the food received is often inadequate, failing to provide sufficient protein, fat, or micronutrients for optimal growth and development. Meeting the minimum required dietary quality is a challenge in many countries and has not been emphasized enough. Children may not receive complementary foods at the right age, may not be fed frequently enough during the day, or may receive poor-quality food. A comprehensive approach includes both counseling for caregivers on the best use of available foods (both local and commercially available) and feeding and care practices, and the provision of micronutrient and food supplements, when needed.

The ability to measure and monitor BF and CF practices might help raise awareness of their importance and facilitate progress in achieving improvements in BF practices worldwide (UNICEF 2006). Understanding the extent to which indicators of dietary quality predict anthropometric outcomes is important for interpreting the meaning of the measurements arising from these indicators (Jones and others 2014). Relatively simple indicators for assessing BF practices have been in wide use since the early 1990s (WHO 1991). However, defining simple CF indicators has proved to be challenging because of its multiple dimensions, the variation in these practices across contexts, and the changes in recommended practices that occur from ages 6 months to 23 months (Arimond, Daelmans, and Dewey 2008; WHO 2008). The WHO IYCF indicators are designed not only for describing trends in IYCF practices over time but also for identifying populations at risk and for evaluating the impacts of interventions. A literature review examining the eight core WHO IYCF indicators (table 12.1) and their relationships with child anthropometry using country-level data suggests that these indicators are especially well suited for monitoring trends in diet quality in large-scale data sets where detailed dietary data cannot be collected; however, they may not be highly sensitive or specific measures of dietary quality in the analysis of the causal pathways to child growth (Jones and others 2014).

The importance of maternal nutrition and its impact on child nutrition and health cannot be sufficiently underscored. To tackle the existing burden of child nutrition, strong emphasis should be focused on improving maternal nutrition even before pregnancy so that women enter pregnancy in the optimal state of health and nutrition. The current global emphasis on adolescence can address a multitude of problems and be the impetus for better women and child health and nutrition.

CONCLUSIONS

Infant and young child nutrition is dependent on the direct determinants of nutrition and growth, including diet, behavior, and health. It is also greatly affected by indirect determinants such as food security, education, environment, economic and social conditions, resources, and governance. Hence, the agenda for combating malnutrition requires a multifaceted approach involving both the interventions directed at the more immediate causes of suboptimum growth and development (nutrition specific) and the large-scale nutrition-sensitive programs that broadly address the underlying determinants of malnutrition.

NOTE

World Bank Income Classifications as of July 2014 are as follows, based on estimates of gross national income (GNI) per capita for 2013:

- Low-income countries (LICs) = US$1,045 or less
- Middle-income countries (MICs) are subdivided:
  a) lower-middle-income = US$1,046 to US$4,125
  b) upper-middle-income (UMICs) = US$4,126 to US$12,745
- High-income countries (HICs) = US$12,746 or more.

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