Chapter 3

Global Nutrition Outcomes at Ages 5 to 19

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INTRODUCTION

Globally, there are 1.8 billion children and adolescents ages 5–19 years; nearly 90 percent live in low- and middle-income countries (LMICs) (World Bank 2015). The prevalence and consequences of malnutrition and inadequate intake of nutrients leading to increased risk of morbidity and mortality are well studied for children in their first 1,000 days (Black and others 2013). Little information about the prevalence and consequences of malnutrition is available for children and adolescents ages 5–19 years, although they constitute 27 percent of the population in LMICs (World Bank 2015).

This paucity of data makes it difficult to develop policies and strategies on why, if, and how to improve the nutritional situation of children and adolescents in LMICs. Available evidence from smaller studies for selected age groups within this cohort suggests that children ages 5–15 years suffer from high prevalence of nutritional deprivation and its consequences. Malnutrition is manifested as underweight (measured by low weight-for-age or body mass index [BMI]), overweight/obesity (measured by high weight-for-age or BMI), and micronutrient deficiencies (essential fatty acids, vitamins, and minerals). Overweight and obesity are caused by excessive intake of energy and, in most cases, suboptimal intakes of essential fatty acids, vitamins, and minerals because of a poor-quality diet.

The objective of this chapter is to use available national surveys, which provide information on the nutritional status at the beginning and end of the entire age range of 5–19 years, to obtain proxy indicators of malnutrition for school-age children. These indicators are compared with those for the larger age groups—for example, all children younger than age five years and all women of reproductive age (WRA)—collected in these studies. The chapter also discusses what is known about dietary intake and the consequences of malnutrition for this age group, as well as what actions are needed globally to address nutritional needs in these age groups. Chapter 11 of this volume (Lassi, Moin, and Bhutta 2017) also looks at nutrition in middle childhood and adolescence. Definitions of age groupings and age-specific terminology used in this volume can be found in chapter 1 (Bundy and others 2017).

PREVALENCE OF MALNUTRITION IN CHILDREN AND ADOLESCENTS AGES 5–19 YEARS

To obtain information on malnutrition during middle childhood and adolescence, the author reviewed the most recent Demographic and Health Surveys (DHS) from 2000 to 2014. DHS are nationally representative household surveys in LMICs that routinely collect height and weight measurements and anemia prevalence for children ages 0–5 years and WRA ages 15–49 years. These data were disaggregated by age group to obtain information on the nutritional status of boys and girls ages 4–5 years (the age group is 4.00 years to 4.99 years or 48–59 months, or before the child's fifth birthday, which is the approximate age

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when children enter school) and a subset of girls ages 15–19 years.[1] Nutritional status information, including anemia caused primarily by iron deficiency and parasitic infections, was available for girls and boys ages 15–19 years in a smaller number of countries.

Underweight and Anemia in Children Younger than Age Five Years in LMICs

Figure 3.1 shows the prevalence of underweight for children ages 48–59 months, compared with children ages 0–59 months.[2] The figure also shows the prevalence of anemia in children ages 48–59 months, compared with those ages 6–59 months.[3] These data are organized by DHS region.[4]

Underweight

In all regions, children ages 48–59 months are as vulnerable to being underweight as all children ages 0–59 months. In West, Central, and Eastern Africa, approximately 20 percent of children ages 48–59 months are underweight; the prevalence is highest in South and South-East Asia, where 43 percent of children in this age group are underweight. The prevalence of overweight and obesity in children younger than age five years is not shown here because, based on the available DHS, the prevalence is less than 5 percent in all regions.

Anemia

To determine the level of public health significance for anemia, the World Health Organization (WHO) provides guidance on the severity of anemia by prevalence at the population level (table 3.1).

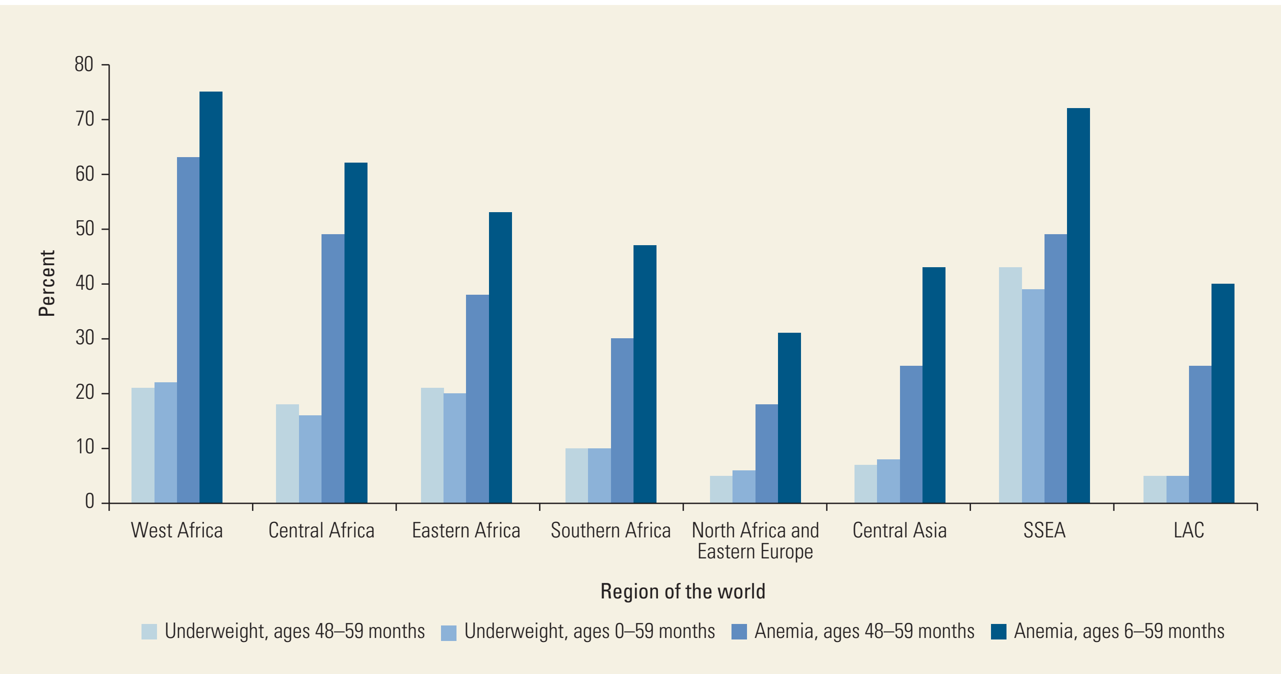
The prevalence of anemia is higher in children ages 6–59 months than in children ages 48–59 months; but anemia prevalence in children ages 48–59 months is still high (20 percent to more than 50 percent of

Table 3.1 Anemia Prevalence and Public Health Significance

Prevalence of anemia at the population level (percent)	Level of public health significance
<5.0	None
5.0–19.9	Mild
20.0–39.9	Moderate
≥40.0	Severe

Source: WHO 2015.

Figure 3.1 Prevalence of Underweight (Low Weight-for-Age) and Anemia (Hb <11 g/dl) in Children Ages 48–59 Months and Children Ages 6–59 Months



Sources: Statcompiler; Demographic and Health Surveys 2000–14.
Note: g/dl = grams per deciliter; Hb = hemoglobin; LAC = Latin America and the Caribbean; SSEA = South and South-East Asia. If there were two surveys in the country during this period, the most recent survey was used.

children in this age group are anemic in all regions). The highest prevalence of anemia is in children ages 48–59 months in West Africa (63 percent) and South and South-East Asia (49 percent). Based on the WHO definition, anemia is a severe public health problem in children ages 48–59 months in these regions.

Underweight and Overweight/Obesity in Adolescents Ages 15–19 Years

The DHS provide prevalence data on underweight (BMI < 18.5 of body weight in kilograms per square of body height in meters [kg/m^2]) and overweight (BMI ≥ 25 kg/m^2) for girls and boys in late adolescence, that is, ages 15–19 years, in 17 countries (figures 3.2 and 3.3).

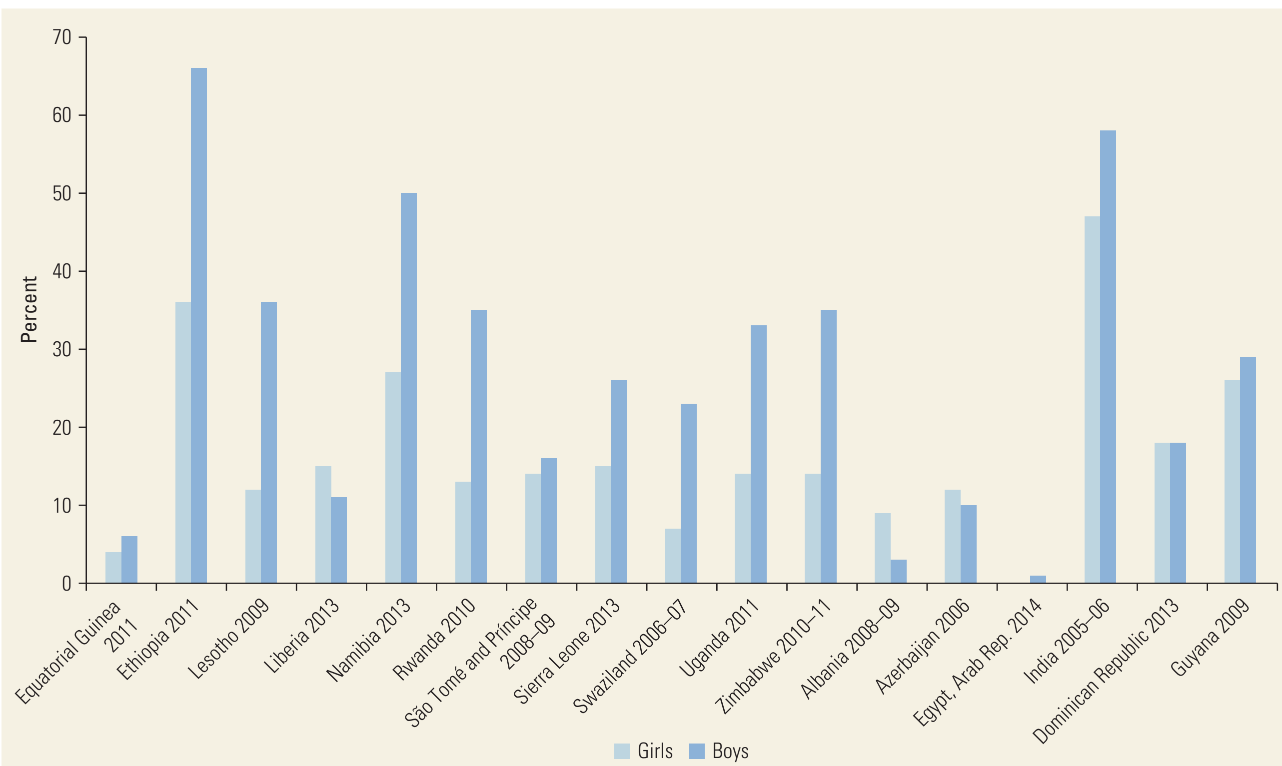
Underweight

The prevalence of underweight in late adolescent girls ages 15–19 years varies from 0.3 percent in the Arab Republic of Egypt (shown as 0 percent in figure 3.2) to 47 percent in India. In boys ages 15–19 years, the prevalence of underweight ranges from 1 percent in Egypt to 66 percent in Ethiopia. In most of the Sub-Saharan African countries shown, the prevalence of underweight in boys is significantly higher than underweight in girls. Data on the prevalence of underweight in males ages 15–49 years were collected in 15 countries.[5] In every country, the prevalence of underweight in late adolescent boys is at least two times higher than the prevalence of underweight in all males ages 15–49 years (data not shown).

Overweight/Obesity

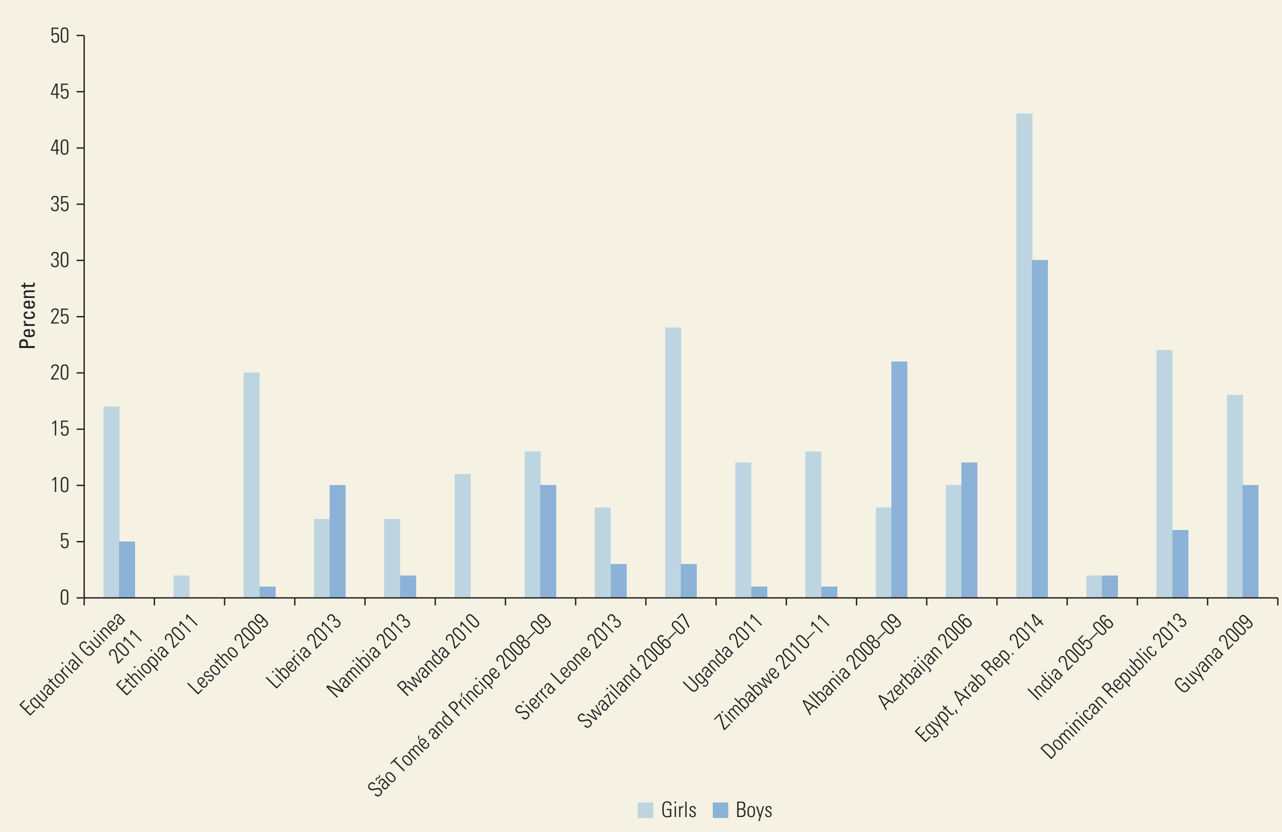
At least 10 percent of either late adolescent boys or girls are overweight or obese in 13 of 17 countries. Overweight/obesity is higher in girls than boys in 13 out of 17 countries; the prevalence in girls is greater than 10 percent in 10 countries, while the prevalence in boys is greater than 10 percent in just 3 countries (figure 3.3). The differential between boys and girls is high in Lesotho, Swaziland, Egypt, and the Dominican Republic. The prevalence of overweight/obesity in girls

Figure 3.2 Prevalence of Underweight (BMI <18.5 kg/m^2) in Adolescents Ages 15–19 Years



Source: Statcompiler; Demographic and Health Surveys (DHS) 2000–14.
Note: BMI = body mass index. If there were two surveys in the country during this period, the most recent country survey was used. Except in the Arab Republic of Egypt where girls ages 15–19 years are unmarried, girls in late adolescence are included in the DHS sample for women of reproductive age in all countries, with most already having a live birth. Cutoffs for underweight in Egypt use <–2 standard deviations.

Figure 3.3 Prevalence of Overweight/Obesity (BMI ≥25 kg/m^2) in Adolescents Ages 15–19 Years



Source: Statcompiler; Demographic and Health Surveys (DHS) 2000–14.
Note: BMI = body mass index. If there were two surveys in the country during this period, the most recent country survey was used. Except in the Arab Republic of Egypt where late adolescent girls ages 15–19 years are unmarried, late adolescent girls are included in the DHS sample for women of reproductive age in all countries, with most already having a live birth. Cutoffs for overweight/obesity in Egypt use >+1 standard deviation.[6]

is lower than in all WRA. For the countries represented in figures 3.2 and 3.3, except Egypt and Equatorial Guinea, where the nutritional status in men ages 15–49 years was not collected, overweight/obesity was significantly higher in men than in late adolescent boys (data not shown). In six countries (Albania, Azerbaijan, Guyana, Namibia, São Tomé and Príncipe, and Swaziland), overweight/obesity in men was greater than 10 percent (data not shown); the prevalence in boys is greater than 10 percent in only three countries (figure 3.3).

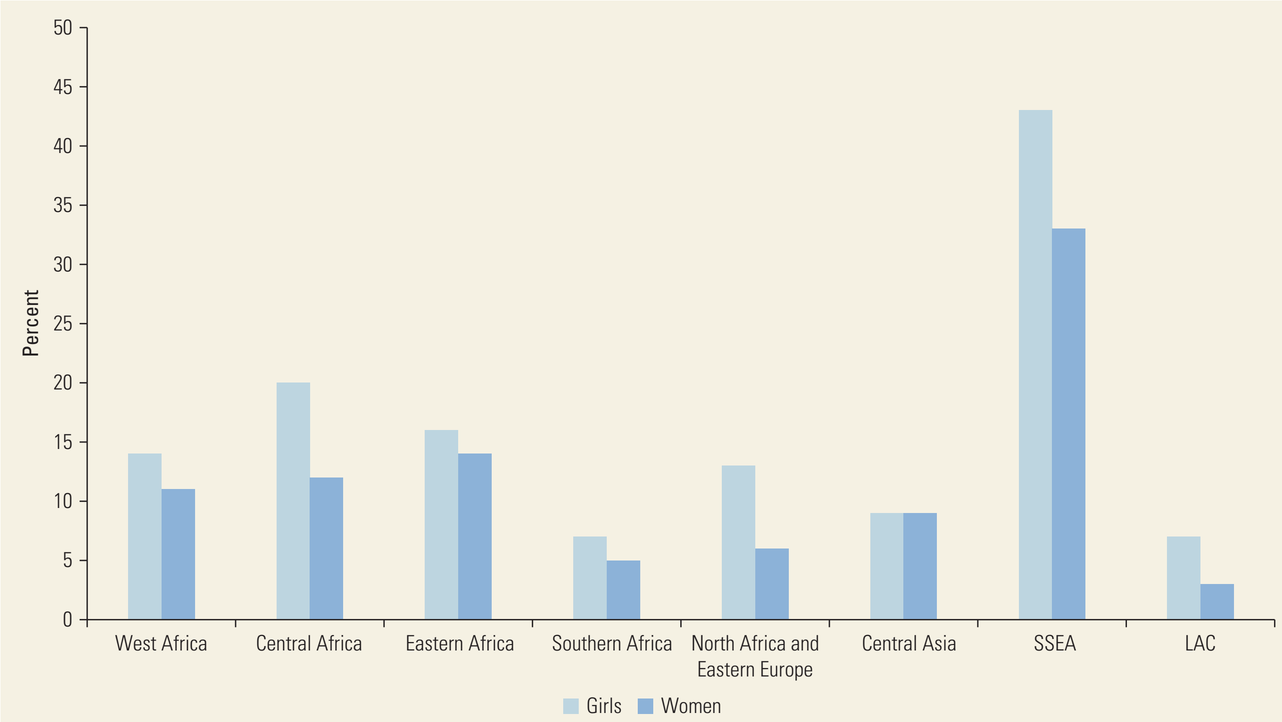
Underweight and Overweight/Obesity in Girls Ages 15–19 Years and Women Ages 15–49 Years

Figure 3.4 reviews the prevalence of underweight (BMI < 18.5 kg/m^2) in girls ages 15–19 years, compared with all WRA by region; 36 countries in Sub-Saharan Africa, 7 in North Africa and Eastern Europe,[7] 3 in Central Asia, 7 in South and South-East Asia, and 11 in Latin America and the Caribbean are represented.

In every region except Central Asia, late adolescent girls are more vulnerable to being underweight than all WRA ages 15–49 years. These differences are high in Central Africa, North Africa and Eastern Europe, South and South-East Asia, and Latin America and the Caribbean, although the prevalence is low in some of these regions. In South and South-East Asia, 43 percent of adolescent girls are underweight, compared with slightly more than 33 percent of all WRA.

Overweight and obesity are increasing in late adolescent girls in some regions; based on the available data, however, the prevalence is much lower than in all WRA. An analysis found that overweight/obesity in boys and girls ages 2–19 years in most LMICs was about half of the overweight/obesity in adult men and women. The study also reported that while overweight has been increasing in boys and girls ages 2–19 years in

Figure 3.4 Prevalence of Underweight (BMI <18.5 kg/m^2) in Adolescent Girls Ages 15–19 Years and WRA Ages 15–49 Years



Source: Statcompiler; Demographic and Health Surveys (DHS) 2000–14.
Note: BMI = body mass index; LAC = Latin America and the Caribbean; SSEA = South and South-East Asia; WRA = women of reproductive age. If there were two surveys in the country during this period, the most recent country survey was used. Late adolescent girls ages 15–19 years are included in the DHS sample for WRA in all countries, with most already having a live birth.

LMICs, obesity has not increased significantly (Ng and others 2014).

Anemia in Girls Ages 15–19 Years and Women Ages 15–49 Years

Figure 3.5 compares the prevalence of anemia in girls ages 15–19 years and WRA ages 15–49 years in 28 countries in Sub-Saharan Africa, 6 in North Africa and Eastern Europe,[8] 2 in Central Asia, 5 in South and South-East Asia, and 5 in Latin America and the Caribbean.

Within regions, the prevalence of anemia in late adolescent girls is similar to the prevalence of anemia in all WRA. Nearly 50 percent of women in both groups are anemic in West and Central Asia and South and South-East Asia. In other regions, 25 percent to 40 percent of women are anemic. According to the WHO definition, anemia is a severe public health problem for late adolescent girls and all WRA ages 15–49 years in West Africa, Central Africa, and South and South-East Asia, with prevalence of at least 40 percent (see table 3.1 for cutoff definitions). Anemia is also a severe public health problem for WRA in Central Asia.

Anemia in Boys Ages 15–19 Years and Men Ages 15–49 Years, Selected Countries

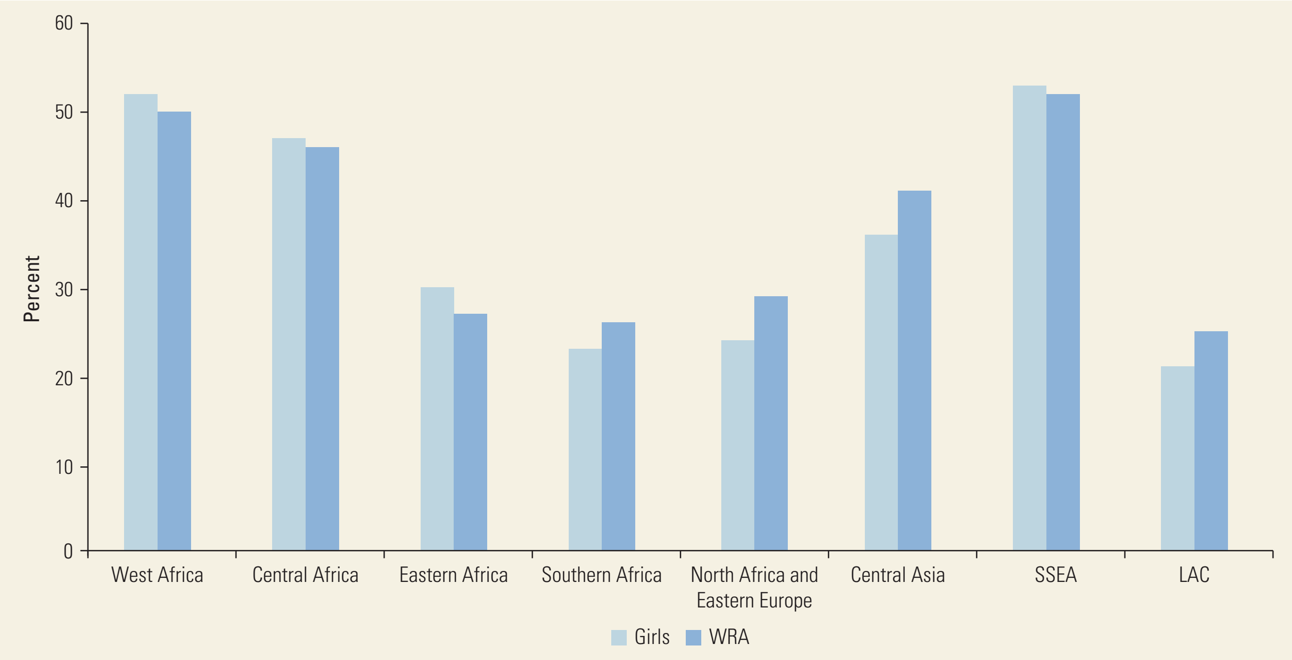
Figure 3.6 presents available data on the prevalence of anemia in boys and men in selected countries.

Compared with men ages 15–49 years, anemia is higher in late adolescent boys. However, anemia prevalence is high in all men and late adolescent boys, affecting more than 20 percent of both age groups in 15 of 22 countries. The prevalence of anemia in late adolescent boys (40 percent or higher) is a severe public health problem in eight Sub-Saharan African countries. Anemia in late adolescent boys is generally lower than in girls in the same age range in the same countries (data not shown).

DIETARY INTAKE OF GIRLS AGES 15–19 YEARS

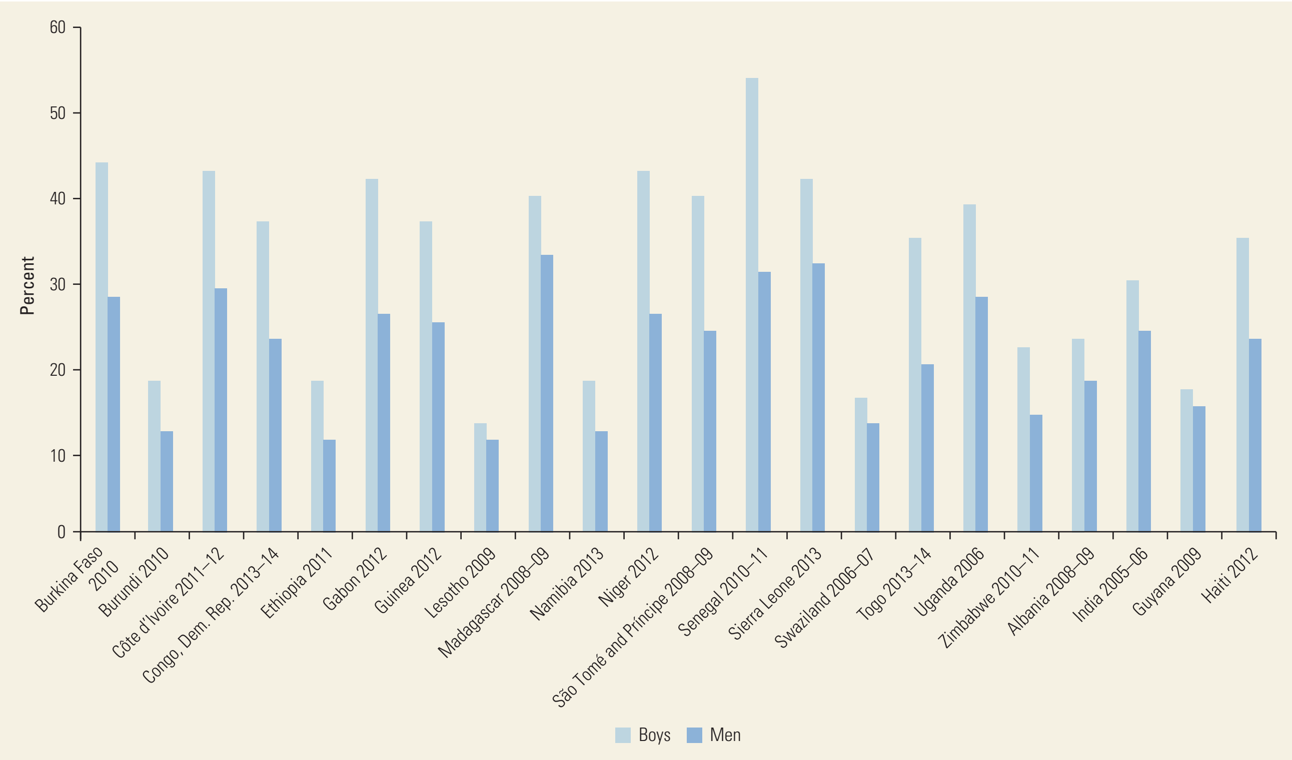
An analysis reviews the available studies, most with small sample sizes, on dietary intake in nonpregnant adolescent girls. These studies are not nationally representative surveys, but they provide information on

Figure 3.5 Prevalence of Anemia (Hb <12 g/dl) in Adolescent Girls Ages 15–19 Years and WRA Ages 15–49 Years



Source: Statcompiler; Demographic and Health Surveys (DHS) 2000–14.
Note: g/dl = grams per deciliter; Hb = hemoglobin; LAC = Latin America and the Caribbean; SSEA = South and South-East Asia; WRA = women of reproductive age. If there were two surveys in the country during this period, the most recent country survey was used. Late adolescent girls ages 15–19 years are included in the DHS sample for WRA in all countries, with most already having a live birth.

Figure 3.6 Prevalence of Anemia (Hb <13 g/dl) in Adolescent Boys Ages 15–19 Years and Men Ages 15–49 Years



Source: Statcompiler; Demographic and Health Surveys 2000–14.
Note: g/dl = grams per deciliter; Hb = hemoglobin. If there were two surveys in the country during this period, the most recent country survey was used.

more vulnerable girls within the entire cohort of adolescent girls. Energy intake was inadequate and did not meet recommended levels in these girls; intakes were lowest in the Western Pacific and South-East Asia (Caulfield and Elliot 2015). Micronutrient intake was inadequate for iron, calcium, zinc, folate, and vitamin D; fewer than 50 percent of girls have adequate intake (Caulfield and Elliot 2015). Intake of energy-dense, micronutrient-poor, and sugary foods by girls is increasing in urban areas in LMICs.

More information is needed on energy and micronutrient intakes during middle childhood and adolescence, given the relatively high prevalence of underweight and anemia in both genders in this group compared with other age groups, and the increasing prevalence of overweight/obesity, particularly in girls, in some countries.

CONSEQUENCES OF MALNUTRITION

Consequences in Children Younger than Age Five Years

Malnutrition inflicts considerable damage on children in their first 1,000 days and increases the risk of short stature, ill health, cognitive impairment, and reduced productivity and income throughout life (Hoddinott and others 2013). As seen from the available data on prevalence, malnutrition is significant for children when they enter school. The ability of children to recover from a period of compromised growth later in life—catch-up growth—has been deemed unlikely (Martorell, Rivera, and Kaplowitz 1990). The inability to reverse stunting may be the result of changes in genetic expression in early life caused by inadequate food intake and infections that determine growth in stature later in life (Golden 1994).

Emerging evidence, however, suggests that a proportion of stunting may be reversible after age two years in Brazil, Ethiopia, India, Peru, and Vietnam (Lundeen, Behrman, and others 2014), Guatemala, India, the Philippines (Adair 1999), and South Africa (Lundeen, Stein, and others 2014). Chapter 8 in this volume (Watkins and others 2017) provides additional information on catch-up growth attributable to immigration, adoption, and other changes. However, in Lundeen, Stein, and others (2014), height deficits related to the reference median also increased, making the interpretation of recovery more complicated. In addition, little is known about how growth and its timing in school-age children in LMICs compares with the growth of children in high-income countries (HICs)—for example, are growth spurts comparable, and is the timing of puberty experiencing the same secular changes as in children in HICs?

Consequences in Children Ages 5–19 Years

Even if stunting in early childhood is not reversible, further damage to nutritional status and cognitive function needs to be prevented. For children ages five to nine years, malnutrition caused by inadequate food intake and helminth infections increases the risk of underweight, anemia, and illness; these conditions decrease attendance, performance, and years in primary school (Bundy and others 2009). In HICs, 15 percent of adult height and 50 percent of adult weight are attained in adolescence (Heald and Gong 1999). In the United States, the period comprising ages 10–14 years is marked by rapid growth and, for girls, the onset of menses (Sawyer and others 2012). By ages 15–19 years, girls attain their adult height, although their pelvis continues to grow, putting girls at risk of obstructed labor later in life if they are undernourished during pelvic development. Boys continue to gain height and muscle mass through age 24 years. Requirements for iron are high for girls after the onset of menarche and in boys because of muscle mass accretion, increasing their risk of anemia and poor performance in school (Halterman and others 2001). Both iron and iodine deficiencies compromise IQ by 8–15 percentage points at the population level (World Bank 2006). Increasing overweight and poor dietary intake put children at risk for nutrition-related chronic diseases that are on the rise in adolescents in LMICs; 20 percent to 30 percent of adolescents live with chronic illnesses, particularly diabetes (Save the Children 2015).

Adolescent girls are at higher risk of poor birth outcomes (prematurity, stillbirths, and neonatal deaths) and of dying than older WRA (Kozuki and others 2013). One study in the United States found that girls younger than age 15 years were at higher risk of maternal anemia, preterm delivery, postpartum hemorrhage, and preeclampsia, but they were less likely to have a cesarean delivery (Kawakita and others 2015). Becoming pregnant is the main reason why girls drop out of school in LMICs (Save the Children 2015), which results in a loss of income of 1 percent to 30 percent of annual GDP (Chaaban and Cunningham 2011). Adolescent pregnancies also may cause higher prevalence of stunting in children younger than age two years (Dewey and Huffman 2009).

CONCLUSIONS

Few nationally representative surveys are available on the nutritional status of boys and girls ages 5–19 years, and this group continues to be understudied for both prevalence of malnutrition and related outcomes from malnutrition. The dearth of information on nutritional status during middle childhood and early adolescence is particularly striking. Mining DHS data for what has been collected on children ages 48–59 months and boys and girls in late adolescence suggests the prevalence of underweight and anemia are high and, for the most part, are on par with or higher than the prevalence in children ages zero to five years, WRA, and men. Overweight is an emerging problem, particularly in girls during late adolescence, but overweight is lower in girls compared with women and in boys compared with men.

Malnutrition in children ages 5–19 years has profound consequences on education and health outcomes, although more studies and analyses could determine the extent of this impact on national development.

Global resources need to be made available to study all children during middle childhood and adolescence (ages 5–19 years), disaggregating the prevalence of malnutrition to children in middle childhood (5–9 years), early adolescence (10–14 years), and late adolescence (15–19 years). Such disaggregated data would assist in developing policies and introducing programs to address the known and suspected nutrition problems of the entire cohort of middle childhood and adolescence to monitor their impact on the nutritional status in this group.

A better understanding of how to measure malnutrition in this age group also would be useful, although not a prerequisite for action. Knowing more about what indicators reflect and mean, the timing of growth spurts in children, and the timing of puberty could help efforts better target interventions by age group. We know that underweight in children younger than age five years is a composite of chronic malnutrition (stunting) and acute malnutrition (wasting). Can we assume this indicator reflects the same composite of stunting and wasting in children ages 5–15 years? Information is emerging about puberty trends in HICs. For example, Sandhu and others (2006) found the onset of puberty in the United Kingdom to be earlier in boys with higher BMI, while height was higher in boys with later puberty. Studies of this kind are needed in LMICs, where it is unclear how important secular changes in adolescent growth are for long-term health and nutritional status (Karlberg 2002).

Finally, more information is needed about nutrition behaviors and how to influence healthy food choices of school-age children. As they grow older, children can make choices about what they eat based on their own food preferences and peer and media influences. However, all children remain dependent on the food that is available in their environment: collected foods, markets, schools, and household. In addition, age and gender differences may influence how food is distributed within the family; older children may influence, in positive or negative ways, what younger children have available to eat.

NOTES

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.

1. The girls in the sample are considered WRA by DHS because they have had at least one live birth and do not represent all girls ages 15–19 years.
2. Indicators are available for low height-for-age (stunting or chronic malnutrition) and low weight-for-height (wasting or acute malnutrition), but because prevalence for these indicators peaks at different times in children ages zero to five years, low weight-for-age, often considered a composite of stunting and wasting, was chosen.
3. DHS collects hemoglobin samples from children ages 6–59 months and does not include children ages 0–5.99 months in the sample.
4. The number of countries for underweight: West Africa (13); Central Africa (5); Eastern Africa (13); Southern Africa (3); North Africa and Eastern Europe (7); Central Asia (2); South and South-East Asia (7); and Latin America and the Caribbean (8). The number of countries for anemia: West Africa (11); Central Africa (6—one study is a Malaria Indicators Survey); Eastern Africa (9); Southern Africa (3); North Africa and Eastern Europe (6); Central Asia (1); South and South-East Asia (5); Latin America and the Caribbean (5).
5. Albania 2008–09, Azerbaijan 2006, Bangladesh 2011, Ethiopia 2011, Guyana 2009, India 2005–06, Lesotho 2009, Namibia 2013, Rwanda 2010, São Tomé and Príncipe 2008–09, Senegal 2010–11, Sierra Leone 2013, Swaziland 2006–07, Uganda 2011, and Zimbabwe 2010–11.
6. Overweight is between +1 standard deviation and ≤+2 standard deviations; obesity is >+2 standard deviations.
7. The Republic of Yemen DHS for 2013 was excluded from the calculations because it was not available on the DHS Statcompiler at the time.
8. The Republic of Yemen was excluded.

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