Pan American Health Organization
Regional Office of the World Health Organization

Underweight, Short Stature and Overweight in Adolescents and Young Women in Latin America and the Caribbean

Introduction

Despite being the period of most rapid growth second only to infancy, nutritional problems during adolescence (defined by WHO as between 10-19 years of age[a]) in developing countries have been largely ignored both as a subject of research in the scientific literature and as a target of public health and nutrition programs. The period of adolescence is not only a time of dynamic physical change, but of psychological, behavioral and emotional development, all of which is likely to be affected by the social and cultural pressures and expectations accompanying the transition to adulthood. In many countries, the inequities between males and females may make adolescent girls at particular risk for poor nutrition and health. At the same time, adolescence may represent a "window of opportunity" during which health problems from earlier in life can be addressed to establish a healthy diet and physical activity that continue into adulthood.[1] The nutrition of adolescent females is not only important in the context of pregnancy and childbearing because of its effect on improving pregnancy outcomes, it is also important for improving the health and nutrition of adolescents for their own current and long-term well-being. As adolescents are estimated to make up approximately 20% of the world's population [2]—or an estimated 1.2 billion people—and young people comprise 24.5% (232 million) of the total population in the Americas, [3] the need for additional information on the nutritional status of this particular age group and targeted strategies for improvement of existing nutritional problems is evident.

Information about the nutritional situation of adolescents is a prerequisite for the development of appropriate policies and programs to improve their nutrition. In the current document, we present an analysis of nationally representative data on anthropometric status of 15 to 24 year-old women from 8 countries in Latin America and the Caribbean (LAC) including Bolivia, Colombia, Ecuador, El Salvador, Haiti, Honduras, Nicaragua, and Peru. The main nutritional indicators included in these analyses are underweight, short stature/stunting, overweight and obesity, and they are discussed at the national level and by urban rural residence. We accompany the presentation of the prevalence and trends for these indicators in the LAC region with a discussion of their causes and consequences, and possible routes of prevention. While male adolescents are at equally high risk of nutritional deficiencies, because of a scarcity of data for young males, as well as the repercussions of inadequate nutrition for future reproductive health among women, the focus of this document will be on young females only.

1. Assessment of underweight, short stature, overweight and obesity during adolescence

Adolescence is the second fastest period of growth after infancy, and thus a period of high nutritional requirements to meet the physiological demand for development. The growth spurt that occurs during adolescence involves not only the skeleton

a The World Health Organization defines the period of adolescence from 10 to 19 years of age; the period defined as "youth" overlaps adolescence and extends to 24 years of age (15-24 years of age); "young people" are defined as all individuals between the ages of 10 and 24. The Ministers of Health of the Americas recently approved a Regional Strategy for Improving Adolescent and Youth Health, which calls for developing and strengthening the health sector's integrated response to adolescents and youth. The proposed interventions in this document are consistent with those called for in the Regional Strategy.

and muscles, but most organ systems (except the brain and head). [4] Approximately 20% of total height gain occurs in adolescence and up to 50% of adult bone mass is achieved during this period. [5] To achieve this growth, nutritional requirements, both for energy as well as micronutrients, increase relative to childhood. Because of the dynamic changes occurring during this period, assessing nutritional status during adolescence, particularly via anthropometric measurements, can be challenging.

Anthropometric indices are combinations of measurements, and in adolescents and young people, the most frequently used indices are based on weight, height, and age and are height-for-age to assess short stature (stunting), and Body Mass Index (BMI)-for-age (where BMI is calculated as weight/height2) to assess underweight and overweight/obesity. All indices are interpreted in comparison to a "reference" growth pattern. WHO has recently constructed a growth curve for school-aged children and adolescents that merged the National Center for Health Statistics (NCHS) growth reference from 1977 (covering individuals aged 1-24 years) with the WHO Under-five Growth Standard cross-sectional data (covering children aged 18-71 months), in order to have a smooth transition from the growth chart for young childhood into older childhood and adolescence.[6] This merged data set results in a smooth transition at 5 years for height-for-age, weight-for-age and BMI-for-age. The values for overweight (1 SD) and obesity (2 SD) compare closely with the cut-offs of >25 kg/m^2 and >30 kg/m^2 for overweight and obesity, respectively. The reference will be referred to in this document as the WHO child/adolescent reference, and is available online (*http://www.who.int/growthref/en/*).

Anthropometric cut-offs for increased current or future health risks among adolescents (e.g., at what level of overweight is the risk of negative health outcomes, such as high blood pressure, increased?) have not been well-established.[5] Thus, statistical cut-offs (e.g., 2 Z-score above or below the reference median) are generally used for this age group. [7] Though definitions can vary, the most common anthropometric indicators for describing the nutritional status of young people (i.e., between 10 and 24 years of age) are:

- ***Stunting or short stature*** among adolescents (10-19 years of age) is defined as height-for-age less than -2 Z-scores of a reference (i.e., the WHO child/adolescent reference). [6, 7] Among adult women (i.e., > 20 years of age), short stature is frequently defined as height less than 145 cm, a cut-off chosen because of its association with increased obstetric risk [8], however other absolute cut-offs have been used in the literature, depending on the study population of interest. Stunting in adolescence is the result of the cumulative effect of poor nutritional status, largely during the first 2 years of life. [9] Although a significant portion of a person's attained height is achieved during adolescence, the negative effects of poor nutrition and repeated infections during early childhood on attained height are difficult to recoup later in childhood, so that children suffering such nutritional insults arrive to adolescence already short. The extent to which early childhood stunting can be "caught-up" during later childhood and adolescence is unclear.

- ***Underweight/thinness*** among adolescents (10-19 y) is defined as a BMI-for age below -2 Z-scores of a reference. [5, 10] In adults (> 20 years) underweight is commonly defined as a BMI less than 18.5 kg/m^2 , corresponding to about -1 Z-score. In adolescents, underweight is generally used as an indicator of current nutritional status, reflecting decreased fat and muscle mass. Because underweight can reflect both low weight and low height, BMI is useful to assess the extent of weight deficit in relation to height.

- ***Overweight*** among adolescents (10-19 y) can be defined as a BMI-for-age greater than +1 Z-score of a reference.[10] In adults (> 20 y) overweight is defined as a BMI greater than or equal to 25 and less than 30 kg/m^2. The +1 SD cut-off for BMI for age at 19 years of age is approximately 25.0 kg/m^2, showing the continuity of the WHO child/adolescent reference with adult cut-offs for overweight.[10] While BMI is a reliable indicator of body fat for most people, for very muscular individuals, BMI may not accurately represent body fatness.

- ***Obesity*** among adolescents can be defined as a BMI-for-age greater than +2 Z-score of a reference.[10] In adults (> 20 years), obesity is defined as a BMI greater than or equal to 30 kg/m^2. Similarly to the case of overweight, the +2 SD cut-off at 19 years of age on the WHO child/adolescent growth reference is approximately the same (29.7 kg/m^2) as the cut-off for obesity used in adults.[10]

Causes of "inappropriate" underweight, short stature and overweight during adolescence

Adolescent girls normally experience the greatest gain in height and weight in the year before menarche [11] with the velocity decreasing dramatically thereafter. Linear growth of the long bones is not thought to be complete until approximately 18 years of age, which generally occurs several years after menarche in most countries.[8] Peak bone mass—which reaches approximately 92% at completion of 18 years of age—is not reached until approximately 25 years of age.[8] Furthermore, in terms of future reproductive health, the growth of the pelvis and birth canal does not follow the same pattern as linear growth; it is thought that mature size of the pelvis is not reached until about 2-3 years after growth in height has ceased.[8] Therefore, as will be more fully explained later in this document, adequate growth during adolescence is necessary to ensure optimal pregnancy outcomes, and avoiding adolescent pregnancy is necessary to ensure optimal growth, as pregnancy and lactation can deplete fat and lean body mass in some settings.[12]

Adequate nutrition—both in terms of overall energy intake, and intake of macro- and micro-nutrients such as iron, calcium and zinc —is necessary to support the increased level of growth during adolescence. There are numerous factors that will affect the most proximate determinants of nutritional status (dietary intake, energy expenditure and illness) among adolescents, particularly among females. Women of reproductive age are at higher risk of nutritional deficiencies not only because of their higher nutritional requirements, but because of gender bias at the household and social levels which prevents adequate access to appropriate foods, and access to and control of economic resources. Females frequently have inadequate education and poor access to health and nutrition services. Though inequality between males and females can begin at earlier ages, discrimination against females can increase with the onset of puberty, when additional cultural restrictions and traditional roles—including the pressure for early marriage and early childbearing—are instituted.

In addition to societal and cultural effects on adolescent nutrition and health, adolescents and young adults have not escaped the effects of the "nutrition transition" which is occurring alongside the "epidemiologic" and "demographic" transitions on a global level. [13] The increased globalization and urbanization occurring in many countries, particularly in the LAC region, shifts disease and nutritional profiles from those characterized by infectious disease and micronutrient deficiencies, towards those characterized by chronic non-communicable diseases associated with excess body weight so that during this transition, both disease profiles exist. [14] Though the physiological cause of overweight and obesity is apparently simple (a persistent imbalance between energy intake and energy expenditure), the societal, cultural, behavioral and environmental conditions that promote and contribute to that imbalance can be complex. In the developing world, including countries of LAC undergoing rapid urbanization, "obesogenic" environments are increasingly common, where high-energy-dense foods are commonly available and accessible, and levels of physical activity (both occupational and recreational) are low. For both males and females, as children become adolescents, their physical activity levels decrease between approximately 1% and up to > 20% per year.[15] Though physical activity is just one component of the equation, women may be disproportionately affected because, in many societies, the physical activity of women may be more restricted than that of men, due to "traditional" roles for women, either in the workplace, in the home, or in physical recreation activities, thus increasing their risk for overweight and obesity. In addition, it has been frequently shown that different cultures have differing views of "ideal" body types for females, which may or may not coincide with a healthy weight. In some settings, pregnancy, because of its associated weight gain, has been associated with increased prevalence of overweight and obesity among adolescents.[16]

Short and long-term negative effects of inappropriate growth during adolescence

Poor nutrition during adolescence and young adulthood not only implies a poorer quality of life and additional health and morbidity risks for the adolescents and young women themselves (both in the short- and long-term), but is directly linked to the health and nutrition of their future children, and their ability to care for and nourish them adequately. Short adults have lower economic productivity,[17] and among women, thinness, or low maternal BMI, has been associated with in-

trauterine growth retardation, the primary cause of low-birth weight in developing countries, and a principal cause of neonatal morbidity and mortality and preschool stunting.[18] An increasing problem in many countries, overweight and obesity among adolescents and young adults, incurs significant long-term effects, including a greater risk of developing type II diabetes, cancer and cardiovascular disease, all of which are associated with premature disability and death. Even in the short-term, however, overweight and obesity among adolescents have been associated with lower self-esteem, and overweight youths may be at greater risk of discrimination.[19]

For physical growth outcomes, many of the negative consequences of inadequate growth among females are related to childbearing. Short maternal stature is associated with both poor pregnancy outcomes, such as low birth weight, and increased risk of pregnancy complications and assisted/operative delivery (i.e., cesarean delivery).[20-22] The relationship between maternal stature and cesarean delivery is thought to be largely due to increased risk of cephalopelvic disproportion (CPD) among shorter mothers.[23] CPD is a condition in which the infant's head or body is too large to pass through the mother's pelvis and a common cause of obstructed labor. The range of cut-off points for predicting CPD and low birthweight are likely to fall between 140 and 150 cm and a cut-off of 145 cm is used to define short maternal stature. [24] In one study of Swedish women, compared with tall women (height > 174 cm), the odds of delivery by cesarean for a short woman (height < 155 cm) were 4.5 times higher.[25] Though shorter women also tend to have smaller infants, the correlation of maternal stature on pelvic size appears to be stronger.[25] In settings where adequate delivery care is available, CPD is commonly addressed by delivering the infant by cesarean section; in contrast, in settings where delivery care is inadequate, or simply unavailable, obstructed labor can be a significant contributor to maternal mortality. Currently, obstructed labor contributes to 13% of maternal deaths in Latin America and the Caribbean, higher than in either Asia (9%) or Africa (4%).[26]

Furthermore, the combined presence of short-stature and maternal fatness, or high BMI, appears to have a synergistic positive effect on increasing obstetric risk. Several studies have shown that while overweight and/or obese mothers as well as short mothers both have increased risk of delivery by cesarean section, the women at highest risk were those that were both overweight/obese and of short stature. In one study of Swedish women, the risk of a non-elective cesarean delivery for a short obese woman was 13 times higher than the risk of delivery by cesarean for a tall, thin woman.[25] At all stages of pregnancy, overweight women are at higher risk of negative outcomes. Prenatally, overweight is associated with a higher risk of pregnancy complications (e.g., diabetes, hypertension, eclampsia), which in turn are associated with intrapartum complications that can lead to cesarean delivery.[25] For example, because of increased prenatal complications, overweight women are more likely to be induced before their due date, which may increase the risk of delivery by cesarean.[25] Overweight women also have prolonged labor with an increased need for oxytocin, conditions which can increase the risk of cesarean delivery.[27] Finally, infants born to overweight mothers are frequently macrosomic, have an increased risk of shoulder dystocia and of suffering birth trauma.[28]

Mothers who are obese at the time of their pregnancy and during the breast-feeding period maintain higher concentrations of glucose and free fatty acids what in turns affects fetal metabolism, tissue growth, and hormonal regulation and possibly inducing lasting epigenetic changes. [29] High prepregnant body mass index is associated with early termination of full and any breastfeeding. [30] In a study of Danish women, those with greater the prepregnant BMI had earlier termination of breastfeeding; the finding of this association in a supportive social context for breastfeeding suggest a biological mechanism for the association. One possible mechanism is reduced prolactin response to suckling as being overweight or obese is negatively associated with this response in the first week postpartum.[31]

Apart from the negative health outcomes for both mother and newborn, the economic costs of overweight and obesity during pregnancy due to increased use of health services are significant: a recent analysis of data from the United States indicated that overweight and obesity was associated with significantly more prenatal fetal tests and visits with a physician, obstetrical ultrasonographic examinations, medications from the outpatient pharmacy, and phone calls to the obstetrics and gynecology department, as well as a longer mean hospital stay for delivery.[32] While in many low-resource settings, there will be limited health-care services available, it is obvious

that additional needs and complications of overweight/obese women during pregnancy—not to mention during the overall lifetime of the individual—will have significant implications for health care costs. Thus, achieving optimal growth during adolescence, and during pregnancy—in terms of adequate weight and height—is essential.

2. Underweight, short stature and overweight of adolescents and young women in Latin America and the Caribbean

Data and methods

We used data from large, nationally-representative surveys provided by the United States Centers for Disease Control and Prevention (CDC) or downloaded from the web with permission from the Demographic and Health Survey (DHS) website (*www.measuredhs.com/accesssurveys/start.cfm*). The DHS are large, nationally-representative household surveys that provide data for a wide range of monitoring and impact evaluation indicators in the areas of population, health, and nutrition using standardized "model" questionnaires so that the data collected are comparable across countries. We included all available nationally representative publicly available datasets with anthropometric data for young women of reproductive age (15-24 years of age) for countries in the Latin America and Caribbean region. Data were available for 8 countries: Bolivia, Colombia, El Salvador, Haiti, Honduras, Nicaragua, Peru and Ecuador. However, because of changes over time in the sample of women selected for anthropometry by the DHS surveys— previously only interviewed women or mothers of children under five years were weighed and measured, or in some surveys, only a subsample of these women were selected for anthropometry, whereas the most recent surveys (phase IV and after) measure all women in a household between 15 and 49 years of age—we analyzed anthropometric data for the most recent surveys only, which occurred between 2001 and 2005. We performed all analyses using SAS for Windows (version 9.1). Descriptive statistics for women 15-24 years of age were done on the main variables of interest for each survey (height and weight) to exclude any outliers or implausible values.

For purposes of analyses of anthropometric outcomes (prevalence of short stature, underweight, overweight and obesity), we created two age groups, 15 to 19 years of age, and 20 to 24 years of age. For the 15-19 year-olds, we defined short stature as height-for-age < -2 Z-score of the WHO child/adolescent growth reference; underweight as BMI-for-age < -2 Z-score of the WHO child/adolescent growth reference; overweight as BMI-for-age > +1 Z-score of the WHO child/adolescent growth reference; and obesity as BMI-for-age > +2 Z-score of the WHO child/adolescent growth reference. For the 20-24 year-old women, we defined short stature as height < 145 cm; underweight as a BMI < 18.5 kg/m^2; overweight as BMI ≥ 25 kg/m^2; obesity as BMI > 30 kg/m^2. For comparison between age groups, we analyzed the data for the 15-19 year-old age group using the adult cut-offs for underweight and short stature. We also stratified the data by urban rural residence. Data for women who were pregnant at the time of the anthropometric measurements were excluded from the analysis of anthropometric outcomes because of the weight changes that occur with pregnancy.

Results

Among both age groups analyzed, overweight was the most prevalent nutritional problem, exceeding all other anthropometric indices for 15-19 year olds in five of the eight countries analyzed and in all countries for 20-24 year-olds (Figures 1 and 2). Only in Ecuador, Peru and Honduras did the prevalence of short stature exceed overweight among 15-19 year-olds. Ecuador had the highest prevalence of overweight young women (30% of 15-19 year-olds and 34% of 20-24 year-olds), closely followed by El Salvador, which had the highest prevalence of obese young women (10.5% and

Figure 1: Prevalence of overweight, obesity, underweight and short stature among 15-19 year-olds in LAC countries with nationally-representative data

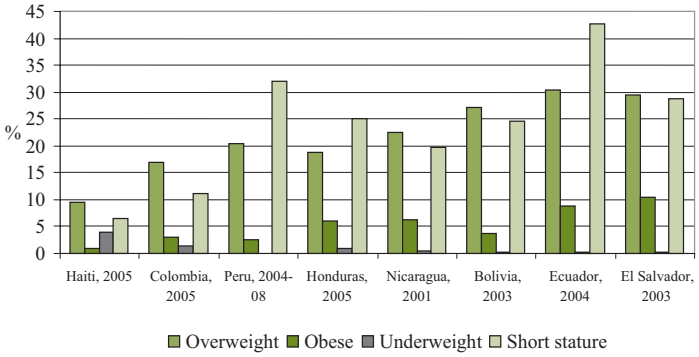
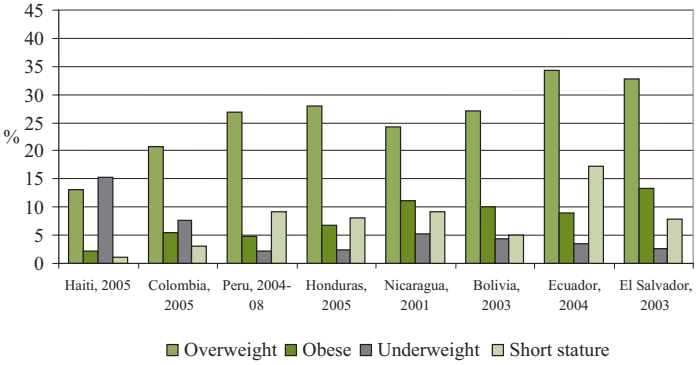
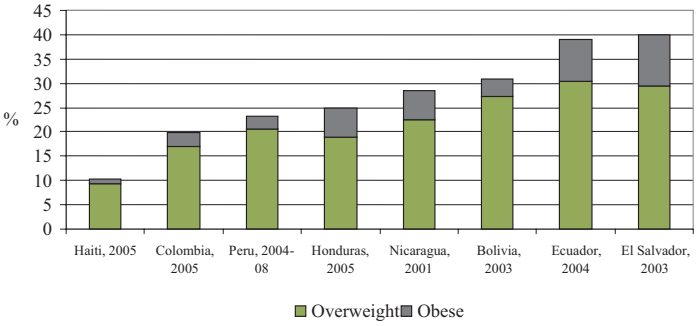


Figure 2: Prevalence of overweight, obesity, underweight and short stature among 20-24 year-olds in LAC countries with nationally-representative data



13.3% of 15-19 and 20-24 year-olds respectively). The cut-offs for overweight and obesity in adolescents < 20 years of age approximate the BMI cut-offs for overweight and obesity in adults and the patterns and prevalence of overweight and obesity were similar across age groups, with a slightly higher prevalence of overweight and obesity in the older age group (Figures 3 and 4).

Figure 3: Prevalence of overweight and obesity among 15-19 year-old women in LAC countries with nationally-representative data



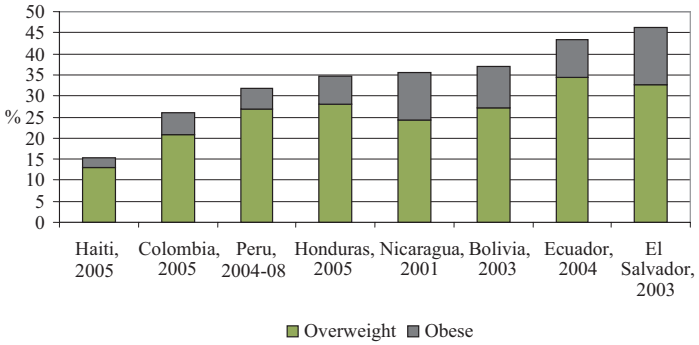
For the younger age-group, 15-19 years of age, short stature (defined as height-for-age less than -2 Z-score of the WHO child/adolescent growth reference) was the next most prevalent outcome, affecting between approximately 7 and 43% of women in this age group. Among adolescents who are still growing, the age-specific WHO cut-off would be the appropriate indicator for shortness, and the high prevalence of adolescents with a height less than -2 Z-score of the height-for-age reference is certainly a cause for concern. However, using a different cut-off for short stature among 15-19 year-olds than what is used among 20-24 year-olds (145 cm is actually closer to -3 Z-scores height-for-age according to the WHO child/adolescent growth reference) gives an artificial impression that the prevalence of "shortness" improves between the two age categories. Thus short stature as defined using "an absolute" cut-off of 145 cm was also assessed among 15-19 year-olds, recognizing that because some linear growth is still occurring in this age group that the estimated prevalence may be an overestimate (Table 1). Using this cut-off, approximately 2 to 14% of 15-19 year-olds would be considered "short". This

Table 1: Prevalence of short stature among 15-19 and 20-24 year-olds using age-specific and absolute cut-offs

	15-19 year-olds		20-24 year-olds
Country, year	**< -2 Height-for age Z-score**	**Height < 145 cm**	**Height < 145 cm**
Bolivia, 2003	24.7	6.6	8.0
Colombia, 2005	11.2	3.0	3.1
Ecuador, 2004	42.7	13.5	17.2
El Salvador, 2003	28.7	9.3	7.9
Haiti, 2005	6.5	1.7	1.1
Honduras, 2005	25.0	11.7	9.1
Nicaragua, 2001	19.7	5.0	5.0
Peru, 2004-08	32.1	9.6	9.2

range is very similar to the range for the older age category, where approximately 1 to 17% of women are of short stature, indicating the similarity in short stature between the two age groups. It is important to note, however, that although height below 145 cm is a commonly used indicator of short stature among women because it is associated with increased obstetric risk, use of this value does not indicate that a height of 146 cm or even 150 cm is "safe" from negative obstetric outcomes.

Figure 4: Prevalence of overweight and obesity among 20-24 year-old-women in LAC countries with nationally representative data



Increased risk of pregnancy complications have been seen at higher cut-offs (including 150 and 155 cm). [27]

It is evident that the presence of overweight/obesity plus short stature—a common pattern among young women in LAC—has a synergistic positive effect on increasing the risk of poor obstetric outcomes.[18] El Salvador and Ecuador are two of the most concerning examples of this pattern: both countries have high prevalence of overweight and obesity (greater than or equal to 40% of 15-24 year-olds), and at the same time, a high prevalence of short stature (roughly 13-17% in Ecuador, and 8-9% in El Salvador, using the absolute cut-off of < 145 cm).

Among the younger age group, underweight (defined as BMI-for-age < -2 Z-score) is the least prevalent problem, well under the prevalence that would be expected in a normally-distributed population (approximately 2%), except in Haiti. Applying the absolute cut-off of 18.5 kg/m^2 to the younger age group does give higher estimates of underweight (between 3 and 22% across countries), as a BMI of 18.5 is roughly equivalent to -1 Z-score of the BMI-for-age reference (Table 2). Among 20-24 year-old women, underweight is also the least prevalent problem, with the exception of Haiti and Colombia. The prevalence of underweight among 20-24 year-old women ranges from a low of 2% in Peru, El Salvador and Bolivia, to a high of 15% in Haiti. There is also an age effect in Haiti, with 20-24 year-olds having a higher prevalence of underweight than 15-19 year-olds.

It has been traditionally expected that individuals residing in rural areas will have higher levels of nutritional deficiencies, either because they do not have the means to achieve a healthy diet, do not have access to medical or nutrition services to prevent or treat these conditions, or have greater levels of infection and disease, increasing their risk of nutritional deficiency. For short stature, among both age groups, the pattern of higher prevalence among rural residents was consistent across countries, except for the younger age group in Ecuador, where the prevalence of short stature was higher among urban residents and in Haiti, where prevalence were similar (Figures 5 and 6). Following the same line of reasoning, it would be expected that overweight and obesity would be higher in urban areas, because of characteristics associated with these areas, including less traditional dietary patterns favoring high energy-dense foods and an increase in more sedentary activities. For both age groups, this pattern was evident in four of the eight countries examined (El Salvador, Haiti, Honduras and Nicaragua) (Figures 8 and 9). However, in the remaining

Table 2: Prevalence of underweight among 15-19 and 20-24 year-olds using age-specific and absolute cut-offs

	15-19 year-olds		20-24 year-olds
Country, year	**< -2 BMI-for age Z-score**	**BMI < 18.5 kg/m^2**	**BMI < 18.5 kg/m^2**
Bolivia, 2003	0.2	4.1	2.3
Colombia, 2005	1.5	13.5	7.6
Ecuador, 2004	0.3	3.1	3.4
El Salvador, 2003	0.2	3.8	2.7
Haiti, 2005	3.9	21.6	15.2
Honduras, 2005	0.9	8.2	5.2
Nicaragua, 2001	0.5	5.9	4.3
Peru, 2004-08	0.1	5.4	2.1

Figure 5: Prevalence of short stature (< -2 Z-score height-for-age) by urban and rural regions, among 15-19 year-old women from LAC countries with nationally-representative data

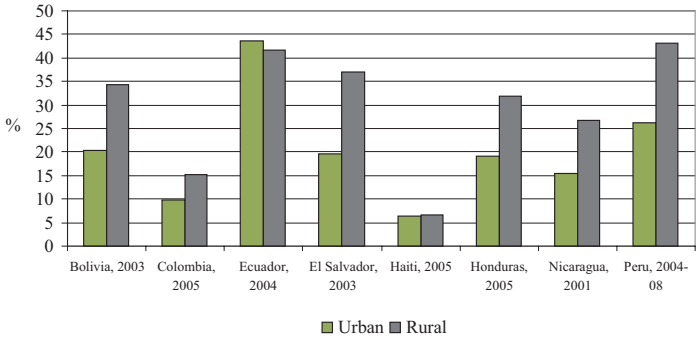


Figure 6: Prevalence of short stature (< 145 cm) by urban and rural regions, among 20-24 year-old women from LAC countries with nationally-representative data

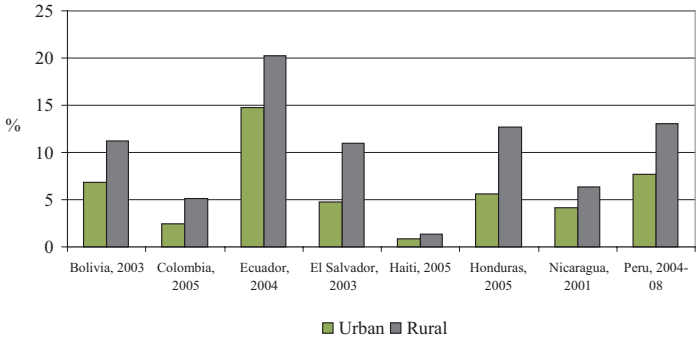


Figure 7: Prevalence of overweight and obesity (> +1 Z-score BMI-for-age) by urban and rural regions, among 15-19 year-old women from LAC countries with nationally-representative data

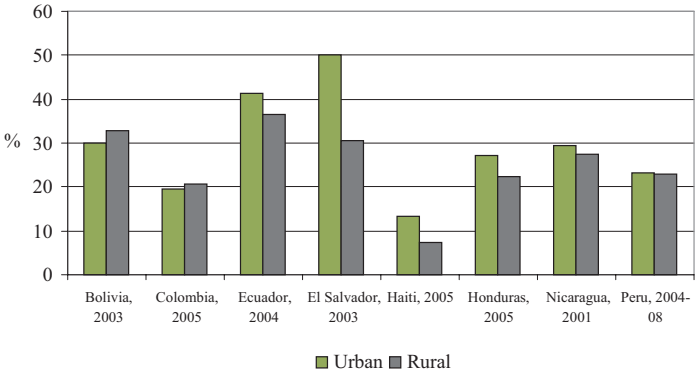
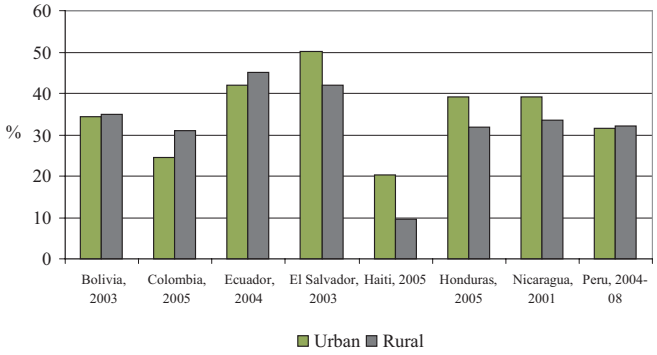


Figure 8: Prevalence of overweight and obesity among 15 Prevalence of overweight and obesity (> 25 kg/m2) by urban and rural regions, among 20-24 year-old women from LAC countries with nationally representative data



countries, the prevalence of overweight and obesity among rural women tended to be equal to or higher than the prevalence among urban women.

3. Improving nutritional status among adolescents and young women in LAC

Reaching adolescents and young women effectively

Adolescents may be more challenging to reach through traditional routes used to access other "high-risk" groups for iron-deficiency and growth counseling (e.g. assessing nutritional status at "well-child" care appointments for infants and prenatal exams for pregnant women), as adolescents may not use health services with the same frequency. [33] An exception may be in settings where reproductive health or HIV programs are established and have already targeted the adolescent population to provide services and education. "Piggy-backing" nutrition education, anemia screening, and treatment onto these programs would not only take advantage of this established link to adolescents, but also reinforce nutritional status as an essential component of reproductive health.

Another potential route of targeting adolescent girls is through schools, although school attendance vary by region (e.g. urban vs. rural), socioeconomic status and cultural influences, and the most at-risk individuals may not be reached through this venue. For growth outcomes, school feeding programs may encourage not only school attendance but ensure adequate eating practices. However, in countries where overweight is more of a problem than underweight, schools should provide healthy, nutrient-rich foods that do not simply increase caloric intake. Religious organizations or teen/women's groups might also be additional routes for reaching this population.

Ensuring optimal growth outcomes

As previously described, achieving "optimal" growth throughout childhood and adolescence implies striking the correct balance between appropriate and sufficient nutrition to ensure the realization of an individual's full growth potential in terms of height, without creating an imbalance between energy intake and energy expenditure that can lead to overweight and obesity. Thus, it is essential that diet offer a balanced composition of essential nutrient and energy content throughout the life cycle.

In the LAC region, overweight and obesity among adolescent females and young women is more prevalent than underweight and short stature still exists at concerning levels. This pattern demonstrates not only the imbalance between nutrition needed for achievement of optimal growth, and excess energy contributing to excess weight, but the importance of timing of nutrition interventions to achieve adequate height. While weight can be gained/lost at any point during the lifecycle, the window of opportunity to achieve maximum child

growth potential is from conception through the first two years of life. Though not all world regions and countries will have the same pattern of nutritional problems, some strategies that could be employed to achieve adequate growth outcomes in adolescents and young women include:

- ***Ensure adequate conditions for growth during the first years of life.***

  Though a significant portion of adult height is gained during the period of adolescence, ensuring that adolescents fulfill their maximal height potential will depend heavily on whether they achieve adequate growth during the first 2 years of life. Stunting during early childhood is a combined result of small birth size, inadequate infant and child feeding practices (including poor breastfeeding and complementary feeding practices) and frequent and repeated infectious disease.[38] Optimizing linear growth in early childhood is dependent on ensuring adequate nutrition and health during pregnancy so that infants are born of adequate size, as well as during the first 2 years of life when height deficits from nutritional or environmental insults are more easily recouped. This is particularly important for later adolescent nutrition as stunting is a risk factor for later obesity and obesity a risk factor for early menarche. Addressing inadequate nutrition and the high incidence of infectious disease after the first 2 years of life will be less effective at preventing or reversing childhood stunting. Thus essential interventions to improve child growth will need to focus on the period of pregnancy through the first 2 years of life. [34]

  There is mixed evidence as to the extent to which stunted children can "catch-up" in growth during adolescence. It appears that catch-up growth during the adolescent growth spurt among children who were previously stunted may be less likely in settings where living conditions remain the same as those that caused the original stunting in childhood.[35] However, improved nutrition during later childhood and early adolescence may hasten menarche, and thus decrease the period of growth, and could actually result in lower achieved adult-height.[35, 36] Further research is needed to determine the role (and appropriate design) of nutrition interventions during adolescence to improve growth. Nonetheless, ensuring adequate dietary practices to avoid micronutrient deficiencies and ensure a healthy weight among adolescents is still of importance.

- ***Prevent adolescent pregnancy.***

  Prevention of adolescent pregnancy is as important for the health and nutrition of the mother as it is for the infant. Pregnancy and lactation can affect growth in the still-growing adolescent, though the underlying level of economic development may determine the direction of the effect. In a study of adolescents in Bangladesh, compared to similarly-aged non-pregnant girls who gained in height, weight, BMI and mid-upper arm circumference, pregnant adolescents did not.[12] However, in a study of adolescents in Brazil, a negative effect of adolescent pregnancy on height was only evident after two pregnancies, while one adolescent pregnancy was associated with greater BMI.[16] Therefore, from a perspective of "optimizing" growth in terms of ensuring adequate height, preventing overweight and obesity, and preventing pregnancy complications and poor birth outcomes, avoiding adolescent pregnancy is a key component. Specific strategies that may encourage later pregnancy include delaying the age of marriage and initiation of sexual activity and also providing education regarding family planning methods for adolescents through not only reproductive health services but other venues that reach out to adolescents.

  However, in the event that pregnancy occurs during adolescence it is essential that barriers to appropriate pre- and post-natal care for both mother and infant are addressed, and access to nutritional and health education and services are ensured. The socioeconomic and behavioral circumstances that surround adolescent pregnancy—pregnant adolescents are frequently poorer than older mothers and frequently enter prenatal care late[37]—also contribute to poor pregnancy outcomes for both the mother and infant.

- ***Create and ensure an environment that encourages and allows healthy dietary practices and permits and promotes adequate physical activity throughout childhood and adolescence.***

  To stem the rising tide of overweight and obesity among children, adolescents and adults, it must be recognized as a

societal problem with root causes in the modern "obesogenic" environment that is increasingly common throughout the world. In such an environment, changes at the individual level will not be sufficient; changes in the environment that enable individuals to make healthy choices regarding their diet and physical activity patterns are needed. Interventions must be holistic in their scope, and include both individual and environmental approaches that begin early in life and involve many community actors—health care practitioners, educators, families and communities—and provide the resources through which adolescents can achieve and maintain a healthy weight.

At the individual level, emphasis should always be placed on improving dietary practices and physical activity for health, rather than focusing on body weight or size, in order to avoid unwanted negative effects on self-image and self-esteem of adolescents.[38] Health practitioners should be trained to assess dietary and physical activity patterns, and counsel adolescents and their families on necessary modifications to their practices or environments, and families should be encouraged to incorporate physical activity and healthy eating practices into their regular family activities.[38]

At the environmental level, schools, and communities need to create an environment where healthy eating and physical activity are possible and supported. Strategies to achieve this include incorporating nutrition education into school curricula, ensuring that healthy foods are provided in school-feeding programs and cafeterias, and unhealthy options are restricted (e.g., high-calorie beverages and junk foods) and creating safe places for adolescents to perform physical activity.[38] In communities, public health campaigns to improve fruit and vegetable consumption and increase physical activity may prove effective at changing dietary and activity patterns. While urban environments are generally associated with greater prevalence of overweight and obesity—because of greater access to high energy foods and lower physical activity levels—as the previous analysis showed, even rural areas are experiencing levels of these conditions that are equal to or greater than those seen in urban areas in some countries. Thus approaches to improve dietary and physical activity patterns will need to be tailored to the characteristics of the populations being served.

4. Nutrition in adolescence: The way forward

Many countries of LAC are experiencing what has been termed the "double burden of malnutrition" where problems of nutritional deficiencies coexist with problems of nutritional excess. The population of adolescents and young women in the countries analyzed are a clear example of the coexistence of these conditions in the same population. Recent national data from LAC countries on growth outcomes indicate that overweight and obesity are by far the most pressing concerns, followed closely by short stature. From a human rights and quality of life perspective, evidence of inadequate nutrition among any age and sex group—either deficiencies or excesses—should be sufficient cause for immediate public health action. That these nutritional problems are occurring among the individuals that will be bearing and principally caring for the next generation, makes action to correct these conditions even more pressing; short stature, underweight and overweight are associated with pregnancy complications, maternal morbidity and death, as well as negative newborn and infant outcomes including low birth weight, prematurity and macrosomia.

The creation of multi-faceted programs will need to be developed and strengthened to address both extremes of the malnutrition spectrum among adolescents: both deficiency conditions and conditions of excess. Strategies should include interventions aimed at both improving the environment to make the healthy choice the easy choice and individual decision-making with respect to dietary practices and physical activity patterns and reducing adolescent pregnancy. In order to effectively reach the groups of young women most affected, development of programs should be tailored to the local cultural, demographic, health, and socioeconomic characteristics of adolescents in each country. In this way, those most at risk will be adequately reached by the developed programs, and the interventions well-received.

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