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Anemia in Latin America and the Caribbean, 2009

Situation analysis, trends, and implications for public health programming

Jose O. Mora, Erick Boy,
Chessa Lutter, and
Ruben Grajeda

Pan American Health Organization
Regional Office of the
World Health Organization

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Executive Summary

Anemia is a global public health problem most often associated with iron deficiency, the most widespread nutrient deficiency in the world. The functional consequences of anemia are serious and include an increased risk of maternal, fetal, and neonatal mortality; poor pregnancy outcomes such as low birthweight and preterm birth; impaired cognitive development, reduced learning capacity, and diminished school performance in children; and decreased productivity in adults. Therefore, monitoring anemia prevalence, trends and policies and programs for its prevention and treatment is important to guide interventions in this area.

This report presents aggregated results on the prevalence of anemia and iron deficiency in countries of Latin America and Caribbean during the period 1981–2009. It provides the most recent data available on the prevalence of anemia at the national, subregional, and regional levels; trends; and estimated numbers of affected children and affected women of childbearing age. It summarizes the current situation of policies and programs to prevent and treat anemia and iron deficiency, and discusses their strengths and weaknesses. A joint initiative of the Micronutrient Initiative (MI) of Canada and the Pan American Health Organization (PAHO), the information in this report will be useful for governments, public health authorities, national policy makers, and other stakeholders interested in preventing anemia and iron deficiency.

Young children, 6-59 months of age, have the highest rates of anemia. The total weighted average prevalence of anemia in young children is 44.5% in the 25 countries with nationally representative data. If this weighted average prevalence is applied to the total number of children of this age in the region (including to those in countries with no representative data), the total estimated number of anemic children would be about 22.5 million. The weighted average subregional prevalence reaches 33.9% in Mexico/Central America, 46.2% in South America, and 42.9% in the Caribbean. National prevalence rates for the group aged 6–11 months are the highest (65.6%) and decline with age.

Among nonpregnant women of reproductive age, the total weighted prevalence of anemia in the 32 countries with nationally representative data is 22.5%. The weighted average subregional prevalence reaches 16.3% in Mexico/Central America, 24.2% in South America, and 29.0% in the Caribbean. If the weighted mean prevalence of the 32 countries covered is applied to the nonpregnant women aged 15–49 years in the region, the estimated population of anemic nonpregnant women would be about 31.7 million.

Among pregnant women, the total weighted prevalence of anemia in the 32 countries with nationally representative data is 30.9%. The weighted average subregional prevalences reach 21.3% in Mexico/Central America, 34.5% in South America, and 42.5% in the Caribbean. If the weighted prevalence rate of the 32 countries covered is applied to the total number of pregnant women in the region, the estimated population of anemic pregnant women would be about 3.5 million.

Virtually no progress has been made in reducing anemia in young children and non pregnant women of reproductive age in contrast to an improving situation in pregnant women. Among the 16 countries with trend data (average interval of 12.1 years), the weighted average prevalence of anemia among young children was 34.0% at baseline and 32.9% in the last survey. Among non pregnant women of reproductive age in 11 countries, the baseline weighted average prevalence amounted to 20.3%, compared to 21.1% in the most recent studies (average interval of 10.4 years). Among pregnant women, the baseline weighted mean prevalence for 15 countries was 43.2%, but the most recent reports indicate a prevalence rate of 28.1%.

Over the past several decades, many LAC countries have established iron supplementation policies and programs. These have been mostly targeted to pregnant women, infants, and preschool children, although a few countries have recently targeted schoolchildren and even nonpregnant women of childbearing age. The key reasons for lack of progress in reducing anemia include, among other factors, low awareness of the problem and weak political commitment to solving it; deficient management, operational, and support systems; and sporadic or nonexistent program monitoring and evaluation.

Inasmuch as anemia is a persistent public health problem with serious functional implications for health and cognitive development, a stronger commitment to address anemia so that it becomes a higher priority and has adequate resources for effective programming and evaluation is required. In particular, advocacy for policy and program development needs to be strengthened, multiple integrated control strategies need to be developed and integrated into primary care; the capacity of the public sector to carry out program interventions needs to be strengthened; and the support of the private sector, community groups, and nongovernmental organizations needs to be enlisted.

Abbreviations

µg	microgram
ACI	amino-chelated iron
AGP	Alpha-1-acid glycoprotein
BCC	behavioral change communication
CDC	U.S. Centers for Disease Control and Prevention
CFNI	Caribbean Food and Nutrition Institute
CI	confidence interval
CRP	C-Reactive Protein test
DHS	Demographic and Health Survey
dL	deciliter
EAR	estimated average requirement
ELISA	Enzyme-Linked Immunosorbent Assay
FA	folic acid
FBG	ferrous bisglycinate
FD	folate deficiency
FF	ferrous fumarate
FHS	Family Health Survey
FS	ferrous sulfate
g	gram
Hb	hemoglobin
ID	iron deficiency
IDA	iron deficiency anemia
INACG	International Nutritional Anemia Consultative Group
kg	kilogram
L	liter
LAC	Latin America and the Caribbean
M&E	monitoring and evaluation
MDG	Millennium Development Goals
mg	milligram
MI	Micronutrient Initiative
mL	milliliter
ng	nanogram
PAHO	Pan American Health Organization
RI	reduced iron
RNI	recommended nutrient intake
SF	serum ferritin
SIVIN	Integrated Nutritional Surveillance System ("Sistema Integrado de Vigilancia de Intervenciones Nutricionales" in Spanish)
VMNIS	Vitamin and Mineral Nutrition Information System
WHO	World Health Organization

Anemia and iron deficiency. A continuing public health problem

Anemia is a global public health problem most often associated with iron deficiency, the most widespread nutrient deficiency in the world (Gillespie & Johnson, 1998; United Nations, 2004; Kraemer & Zimmermann, 2007). It affects variable proportions of the population in both developing and developed countries, with three to four times higher prevalence in the developing world. The World Health Organization (WHO) estimates that nearly one-third of the world's population is anemic (WHO/UNICEF/UNU, 2001). A more recent estimate concludes that, worldwide, almost half of preschool children and pregnant women and close to one-third of nonpregnant women suffer from anemia (McLean et al., 2007, 2008). Children under 3 years of age, pregnant and nonpregnant women, and female adolescents are the groups at highest risk.

In Latin America and the Caribbean (LAC), by the middle of the 1990s, the proportion of the population suffering from anemia was estimated to exceed 100 million—nearly 20% of the total population. Those affected include 22 million children younger than 5 years, 26 million children aged 5–14 years, 26 million nonpregnant women of childbearing age, 4 million pregnant women, 11 million males aged 15–45 years, and 12 million people older than 45 years (Mora & Mora, 1997).

BOX 1

Health and Functional Consequences of Anemia

√ Increased risk of maternal, fetal, and neonatal death
√ Low birthweight and preterm birth
√ Delayed cognitive development and reduced learning capacity in children
√ Decreased productivity in adults

Anemia is recognized as a major threat to the health, survival, and well-being of the individuals affected. The functional consequences of anemia are serious. They include an increased risk of maternal, fetal, and neonatal mortality (Bothwell and Charlton, 1981; Black et al., 2008); poor pregnancy outcomes such as low birthweight and preterm birth (Allen, 2000; Brabin et al., 2001); impaired cognitive development, reduced learning capacity, and diminished school performance in children (Pollitt, 1997, 2001; Grantham-McGregor, 2001; Walter, 2003, Lozoff et al., 2006; Lozoff & Georgie, 2006); and decreased productivity in adults (Hass & Brownlie, 2001). Anemia reduces survival rates, deteriorates the quality of life, and diminishes the physical and mental development of the populations affected. It also lowers productivity and leads to significant economic losses in countries where the prevalence of anemia is high (Ross and Horton, 2000).

Anemia is defined as low levels of hemoglobin derived from insufficient or abnormal hemoglobin and red cell production and/or excessive red cell destruction and iron losses. Among the multiple causes of anemia, iron deficiency (ID) appears to be the most important, accounting for about 50% of the cases in developing countries. The term "iron deficiency anemia" (IDA), which correctly applies only to anemia cases caused by ID, has been widely used to refer to anemia in general. However, iron deficiency is not the only cause of anemia, which also results from a number of other factors (WHO/UNICEF/UNU, 2001). Therefore, the terms IDA and anemia are not interchangeable. At the same time, it is important to recognize that iron deficiency does not always cause anemia, and not everyone with ID is anemic. More than 3.5 billion people in the developing countries are estimated to be affected by ID, with or without anemia—about 2.5 times the total anemic population (UNICEF/UNU/WHO/MI, 1999; WHO/UNICEF/UNU, 2001). ID alone tends to have functional implications similar to those of anemia and IDA (Allen, 2000; Bothwell and Charlton, 1988; Grantham-McGregor and Ani, 2001; Hass and Brownlie, 2001; Lozoff and Georgie, 2006; Lozoff et al., 2006; Pollitt, 1997, 2001; Walter, 2003).

Low dietary intake of bioavailable iron is an important cause of IDA. This is usually combined with factors leading to low absorption and utilization of iron, or excessive losses of dietary iron, for example, as a result of diets with a high content of inhibitors of iron absorption (e.g. phytates, polyphenols) or low intake of iron absorption enhancers (e.g. citric fruits and vegetables rich in vitamin C), parasitic diseases, systemic infections, or other nutritional deficiencies (vitamin A and some B-complex vitamins). Various interventions can be used to address deficient iron intake and absorption. These include providing iron supplements to vulnerable groups, such as women and children (Viteri, 1997), and undertaking nutrition education to promote dietary diversification, increased consumption of iron absorption enhancers and reduced intake of inhibitors through changes in dietary practices (Hyde et al., 2003). Food-based approaches include the fortification of staple foods (WHO/FAO, 2006; Hurrell & Egli, 2007) and other measures such as genetic enhancement that can improve the level of bioavailable iron in foods (Ruel and Levin, 2000). Preventing and treating parasitic diseases such as malaria, hookworms, and schistosomiasis can help prevent excessive iron loss.

In general, anemia control remains a relatively low priority on the public health agenda. This is the case despite extensive information on the magnitude of the problem and a growing body of evidence on the health, functional, and economic implications of anemia for the individuals and populations affected. The availability of portable photometers, such as HemoCue, has led to increased interest in assessing the magnitude and severity of anemia in developing countries and its implications for health and development. These photometers can be used to rapidly assess hemoglobin levels, using a blood spot, in a relatively noninvasive manner and at a reasonable cost. However, little progress appears to have been made worldwide in reducing anemia (Mason et al. 2001, 2005). This may be related to the lack of comprehensive, effectively integrated programs, persistent operational problems, and the fact that most intervention programs have been designed specifically to address iron deficiency. Although ID is the most important cause of anemia in many settings, it nonetheless accounts for only about half of all cases. Unfortunately, current anemia control efforts do not usually include targeted actions to address factors other than ID.

Objectives and organization of the report

This report provides the most recent country estimates on anemia prevalence and trends, as well as estimates of the numbers of children and women of childbearing age who are affected in Latin America and the Caribbean. By providing a baseline that can be used to track trends in anemia and ID, this report will help national decision makers and international cooperation agencies evaluate the progress made toward established goals. The ultimate objective of the report is to promote stronger commitment to address the problem of anemia and ID so that it becomes a higher priority, leading to allocation of adequate resources for effective programming.

The information provided in this report will be useful for country governments, public health authorities, national policy makers, and other stakeholders (academics, health care providers, nutrition specialists, and the general public). These groups require updated information on anemia and ID in order to effectively formulate policy, plan programs, and conduct evaluations. The information may also help generate broader public and private sector awareness that anemia is a significant and persistent public health problem affecting the social and economic development of many countries of the region.

The remainder of the report is organized into the following major sections: an overview of research methods and data sources; presentation of anemia and iron deficiency prevalence, trends, and estimates of numbers affected; a look at current policies and programs to control anemia in the region; analysis of why anemia remains a significant public health problem; and recommendations for meeting the challenge of reducing anemia and iron deficiency.

Research methods and data sources

The research process involved a "snowball" methodology. Researchers first identified Demographic and Health Surveys (DHS), Family Health Surveys (FHS), and other national health and nutrition reports. They then contacted micronutrient experts and ministry of health authorities, tracked down key documents identified in the bibliographies of country reports, accessed the WHO Global Database on Anemia within the Vitamin and Mineral Nutrition Information System (VMNIS, http://who.int/vmnis), reviewed international publications addressing the magnitude and trends of anemia, and reviewed analyses of existing anemia control programs in LAC countries. Researchers distributed a questionnaire to LAC country health authorities to learn about existing anemia control programs, with an emphasis on iron/folate supplementation and food fortification.

In selecting country reports containing data on the prevalence of anemia in representative samples of the population at the national or subnational level, we reviewed the research design, data collection methods, analytical methods (including cutoff points for prevalence estimates), and results of survey reports that provided details of the sample and methods used in reporting anemia prevalence. Surveys restricted to specific localities were excluded. The survey reports that were selected were initially grouped in two categories based on the type of information they provided on the prevalence of anemia in preschool children and/or women of childbearing age:

- Reports of studies that used nationally representative samples of the population or randomly selected samples from health centers and compiled information from records of women attending antenatal clinics.

- Reports of subnational studies using relatively large samples of specific population groups (preschool children and/or women of childbearing age).

We used information from nationally representative samples in 20 countries to estimate the most recent prevalence of anemia, assess trends over time, and estimate the size of the population affected by anemia in each country. The national studies that were selected used either (a) population-based, multistage sample selection designs with probabilistic cluster samples of households with children and women of childbearing age, or (b) facility-based designs, that is, they used random samples of health centers to collect data on children or review information previously collected from pregnant women attending antenatal clinics. For some countries, prevalence estimates are based on the results of separate national nutrition studies usually carried out by ministries of health among children and/or women.

The national studies from which country estimates were made used internationally accepted methods of specimen (blood) collection and assessment of hemoglobin levels in capillary or venous blood using quantitative photometric methods or automated cell counters (Dirren et al., 1994; CDC, 1997; Nestel, 2002). The results were adjusted for altitude, although, with the exception of Argentina, not for smoking habits. The following internationally accepted cutoffs were used to calculate prevalence estimates of anemia based on hemoglobin levels (WHO/UNICEF/UNU, 2001):

Population group	Hemoglobin cutoff
Children 6–59 months	110 g/L
Nonpregnant women 15–49 years	120 g/L
Pregnant women	110 g/L

Information was available from 18 national studies that assessed the prevalence of anemia in preschool children, 17 that assessed nonpregnant women aged 15–49 years, and 18 that assessed pregnant women (tables 1 and 2). Of the 18 studies, 11 were comprehensive nutrition and health surveys carried out by health ministries. The other seven were DHS/FHS-type studies covering a variety of demographic, nutrition, and health topics. In order to increase the number of countries with prevalence data, estimates for countries with no recent national representative surveys (15 for children aged 6–59 months, 15 for nonpregnant women, and 15 for pregnant women) were abstracted from the WHO Global Database on Anemia (http://who.int/vmnis), which compiles data on hemoglobin concentration and anemia prevalence by country.

For 15 countries, we determined the prevalence of anemia in children aged 6–59 months by abstracting from WHO-VMNIS estimates that were generated through regression equations using the United Nations Human Development Index and some health indicators from the World Health Statistics database. In the case of Brazil, however, the prevalence of anemia among preschool-age children, pregnant women, and nonpregnant women of childbearing age was based on subnational rates weighted by the estimated general population as determined by the most recent available census data. WHO estimates for nonpregnant women and for pregnant women, based on regression equations, were abstracted for 15 and 15 countries, respectively. The WHO regression equations explained 55.0%, 45.3%, and 32.3% of the variation in anemia prevalence among preschool children, nonpregnant women, and pregnant women, respectively (McLean et al., 2008).

We used recent national studies and estimates from the WHO to determine prevalence rates of anemia by country, by subregion (Mexico/Central America, South America, and the Caribbean), and for the LAC region as a whole. We took into account data on children aged 6–59 months from 25 countries, children aged 12–59 months from 18 countries, and both nonpregnant women aged 15–49 years and pregnant women from 32 countries. The prevalence of anemia as a public health problem has been categorized as follows: <5% prevalence, no public health problem; 5–19.9%, mild problem; 20–39.9%, moderate problem; >40%, severe problem (WHO/UNICEF/UNU, 2001).

With respect to countries that had conducted repeated surveys, we estimated trends in prevalence rates by comparing the results obtained from two nationally representative samples, including the most recent study. Baseline study reports were not reviewed, although some of the baseline rates were quoted from the WHO database or from Mason et al. (2005). For each country, the difference in prevalence between the baseline and the most recent study and the interval between them in years were calculated. In addition, the change relative to the baseline prevalence and the average change per year were calculated in percentage points. The baseline and most recent mean prevalence of anemia for the group of countries with repeated surveys was calculated by weighting each prevalence rate by the total number of children or women from each country relative to the total in all the countries with data, based on population estimations for mid-2005 provided by the Population Reference Bureau (2006).

The estimated prevalence rates were also used to estimate the size of the population affected by anemia—by country and subregion, and for the total region—based on population projections for mid-2005 from the Population Reference Bureau (2006). We derived the number of pregnant women by taking the expected number of births and adding 2% to account for stillbirths. The stillbirth rate in LAC countries in 2005 ranged from 10 to 30 per 1,000 pregnancies (Stanton et al., 2006).

A limited number of studies from a country assessed ID using serum ferritin (SF), as well as IDA in children or women from eight countries. A summary of the results of these studies is reported. A total of 16 national studies assessed SF; eight studies focused on preschool children, four focused on women 15–49 years, and four considered pregnant women. For SF assessment, Enzyme-Linked Immunosorbent Assay (ELISA) kits from RAMCO Laboratories or the Immunometric Assay Sandwich method were used. Other proposed iron indicators (e.g., zinc protoporphyrin, transferring saturation, and transferring receptors) have been used rarely in population studies and therefore are not included in this review. The results from the few studies assessing folate deficiency in population groups are briefly mentioned.

Finally, we summarizes available information from 11 countries on current policies and strategies to control anemia, as well as specific program interventions such as iron/folate supplementation, food fortification, deworming, home fortification, and fortified complementary foods.

Anemia and iron deficiency prevalence, trends, and numbers of affected women and children

Early in the research process, it was clear that nationwide studies preferentially covered children under 5 years of age (either 6–59 or 12–59 months), pregnant women, and/or nonpregnant women of childbearing age (15–49 years). The review, therefore, focuses on these three population groups. In the standard national studies that use a household survey design, sample sizes of pregnant women tend to be relatively small (hundreds rather than thousands) compared to samples of children and nonpregnant women. Larger sample sizes are seen in studies that select health care centers either to recruit women for hemoglobin assessment or to compile data from the clinical records of women attending antenatal clinics.

There are 38 countries in the LAC region: 8 in the Mexico/Central America subregion, 13 in South America, and 17 in the Caribbean (including Puerto Rico). Information on national prevalence was available for children aged 6–59 months from 25 countries, for children aged 12–59 months from 18 countries, and for both pregnant women and nonpregnant women aged 15–49 years from 32 countries. This information was drawn either from the most recent survey reports within the period 1993–2009 or from recent WHO estimates. Data abstracted directly from reports of national surveys were available for the following groups: children aged 6–59 months from 11 countries, children aged 12–59 months from 18 countries, nonpregnant women aged 15–49 years from 17 countries, and pregnant women from 17 countries. Prevalence for other countries was abstracted from the WHO Global Database on Anemia (http://who.int/vmnis).

Country summaries of national surveys

This section provides a brief description of the main results reported from the most recent national studies carried out in nationally representative samples (actual data shown in tables 1 and 2).

Antigua and Barbuda. A national study conducted by the Caribbean Food and Nutrition Institute (CFNI/PAHO) in 1996 (Antigua/Barbuda, 1997) covered a sample of 81 children aged 12–59 months and reported anemia prevalence of 49.4% (47.7% in males, 51.3% in females). A similar study in children 12–59 months in 1985 reported 55% prevalence.

Argentina. A national health and nutrition survey was conducted in 2005 (Argentina, 2007; Koga et al., 2008) in 21,010 children aged 6–72 months, 5,322 nonpregnant women 10–49 years, and 1,321 pregnant women. Reported anemia rates were as follows: 16.5% in children aged 6–72 months (19.0% urban, 15.2%% rural), 18.7% in nonpregnant women aged 10–49 years (not broken down by urban/rural), and 30.5% in pregnant women. More detailed age breakdowns for children gave the following estimates: 34.1% in children aged 6–23 months and 8.9% in children aged 24–72 months (estimated 47.6% for 6–11 months, 20.2% for 6–59 months, and 12.5% for 12–59 months).

Belize. In 1995, hemoglobin data were compiled from 6,402 pregnant women attending antenatal clinics, showing a total anemia prevalence of 51.7% (Belize, 1997). A previous study in 1984 reported a prevalence of 49.3% in pregnant women.

Bolivia. The most recent national survey was completed in 2008 (Bolivia, ENDSA 2010), involving a sample of 2,552 children, 5,704 nonpregnant women aged 15–49 years, and 324 pregnant women. Reported anemia rates were 61.3% for children aged 6–59 months (55.7% urban, 67.6% rural, estimated 59.8% for children 12–59 months), and 34.9% for nonpregnant women (36.0% urban, 42.3% rural for nonpregnant, pregnant and lactating combined) and 49.4% for pregnant women. The 1998 ENDSA (Bolivia, ENDSA 1998) found anemia prevalence of 55.6% in children aged 6–59 months and 27.1% in nonpregnant women (15 – 49 years). The 2003 ENDSA (Bolivia, ENDSA 2004) found anemia prevalence of 51.0% in children aged 6–59 months and 32.8% in nonpregnant women.

Brazil. A subnational study was completed in 2005. It involved a probabilistic sample of 2,715 infants aged 6–11 months from 12 municipalities in five regions of the country (Neumann-Spinelli et al., 2005). A prevalence rate of 65.4% was found. No countrywide studies have been reported.

Chile. The most recent national survey was completed in 2003 (Resultados I Encuesta de Salud, Chile 2003) involving a sample of 731 nonpregnant women aged 17 – 44 years. Reported anemia rates were 4.8%.

Colombia. The most recent National Nutrition Survey (Colombia, 2005) used a nationally representative sample of 5,558 children aged 12–59 months, 3,851 nonpregnant women aged 13–49 years, and 667 pregnant women. The reported anemia prevalence was 33.2% for children (30.8% urban, 39.1% rural, 32.2% males, 34.2% females), 32.8% for nonpregnant women (33.2% urban, 30.9% rural), and 44.7% for pregnant women. At the time of the survey, about 76% of the women who had been pregnant in the past five years had regularly consumed iron supplements (80.0% urban, 65.3% rural). A previous national nutrition survey in 1995 reported an anemia prevalence of 23.3% in children aged 12–59 months and 22.5% in nonpregnant women aged 15–49 years (Castro and Nichols, 1998).

Costa Rica. The most recent national micronutrient survey was conducted by the Ministry of Health in 1996 with a representative sample of 961 preschool children aged 12–71 months and 888 women of reproductive age (820 nonpregnant, 68 pregnant). Anemia prevalence was 26.3% in children aged 12–71 months (estimated 22.1% in the group 12–59 months), 18.6% in nonpregnant women aged 15–44 years (17.4% urban, 21.7% rural), and 27.9% in pregnant women. The official 1996 report published by the Ministry of Health (Costa Rica, 1996) and two subsequent published articles (Cunningham et al., 2001; Rodriguez et al., 2001) differ somewhat in their prevalence estimates.

Cuba. In 1999, two national studies, by Jimenez and Gay-Rodriguez, reported 27.0% anemia prevalence in 3,217 pregnant women (compilation of antenatal records) and 15.5% in 3,222 nonpregnant women (cited in FAO Nutrition Country Profiles, Cuba, 2003).

Dominica. A 1996 study by CFNI/PAHO used a national sample of 157 children aged 12–59 months and 148 pregnant women. The study observed an anemia prevalence of 34.4% and 35.6%, respectively (Dominica, 1997). The research report also quotes a 1985 study that detected 46% prevalence in children aged 12–59 months and a 1988 study that found 24.7% prevalence in pregnant women.

Dominican Republic. The most recent national survey was completed in 2008 (Republica Dominicana, Encuesta Nacional de Micornutrientes 2009), involving a sample of 772 chilren 6–59 months and 1,129 non pregnant women aged 15–49 years. Reported anemia rates were 28.0% for children aged 6–50 months (25.0% urban, 36.0% rural, estimated 24.8% for children 12–59 moths), and 34.0% for nonpregnant women (34.0% urban, 33.0% rural). The previous national study on anemia was conducted by the Centro Nacional de Investigaciones en Salud Materno–Infantil (CENISMI, 1993). Researchers used a national sample of 765 children aged 12–50 months. The total prevalence amounted to 32.0% in children (30.7% urban, 40.0% rural). The report did not disaggregate prevalence rates by age group.

Ecuador. The most recent nationally representative study on anemia was carried out in 1997. It involved representative samples of 1,083 children aged 6–59 months, 1,916 women aged 15–49 years, and 130 pregnant women. The official study report contains some inconsistencies. A reanalysis of the database was carried out in 2007 by Humberto Méndez, from INCAP, using the hemoglobin adjustment method of the CDC. It revealed anemia prevalence of 60.2% overall in children (55.2% urban, 65.8% rural; 59.8% in children aged 12–59 months), 47.4% in nonpregnant women (44.4% urban, 52.9% rural), and 56.9% in pregnant women (Méndez, personal communication). A 1986 national nutrition survey reported 22.3% prevalence in children aged 12–59 months (Freire et al., 1988).

El Salvador. The most recent national survey (El Salvador, FESAL 2008) covered 3,836 children aged 6–59 months, 3,633 nonpregnant women aged 15–49 years and 296 pregnant women. It reported a 26.0% prevalence of anemia in children (23.4% urban, 28.3% rural, 27.0% males, 24.9% females), a 9.6% prevalence in nonpregnant women (9.8% urban, 9.5% rural), and a 7.5% prevalence in pregnant women, with some significant differences by department. The 2003 FESAL (El Salvador, FESAL, 2004) found a 19.8% prevalence of anemia in children aged 12–59 months and 8.8% prevalence among non pregnant women.

Guatemala. The most recent study (Guatemala, ENSMI 2002) covered a sample of 4,016 children aged 6–59 months, 3,062 women aged 15–49 years, and 541 pregnant women. Reported anemia prevalence was 39.7% for children aged 6–59 months (36.4% estimated for 12–59 months), 20.2% for nonpregnant women, and 22.1% for pregnant women. The CDC (1997) reference values by trimester of pregnancy were used to define anemia in pregnant women. A national nutrition survey was conducted in 1995, reporting a 25.9% anemia prevalence in children aged 12–59 months (Guatemala, 1995).

Guyana. A national micronutrient study was carried out in 1996–97 (Guyana–CFNI/PAHO, 1997) in a national sample of health centers, covering 140 children aged 12–59 months, 447 nonpregnant women aged 15–49 years, and 269 pregnant women. Anemia prevalence was 47.9% in children aged 12-59 months. The study also reported 53.9% prevalence in nonpregnant women and 52% prevalence in pregnant women. The report cites a 1971 study that found 41% prevalence in children 12–59 months.

Haiti. The most recent national anemia assessment was conducted in 2005/06 using a representative sample of 2,599 children aged 6–59 months, 4,945 nonpregnant women aged 15–49 years, and 290 pregnant women (Haiti, 2007). The overall prevalence amounted to 60.6% in children aged 6–59 months (estimated 59.9% for 12–59 months), 45.5% in nonpregnant women, and 50.3% in pregnant women. A 2000 national study reported anemia prevalence rates of 63.1% in children aged 12–59 months, 54.4% in nonpregnant women, and 63.2% in pregnant women (Haiti, 2001).

Honduras. The most recent survey (Honduras, ENDESA 2005–06) covered 8,649 children aged 6–59 months, 17,323 nonpregnant women aged 15–49 years, and 1,042 pregnant women. Anemia prevalence rates were observed to be 37.3% in children aged 6–59 months (estimated 34.3% for 12–59 months), 18.6% in nonpregnant women, and 21.4% in pregnant women. A 1996 national study found 33.4% prevalence in children aged 12–59 months.

Jamaica. The most recent national study was conducted in 1997 by CFNI/PAHO (Jamaica, 1998) using a randomly selected sample of health centers to cover 272 children 12–59 months and 343 pregnant women attending antenatal clinics. Anemia prevalence was reported to reach 48.2% in children (59.2% males, 39.5% females) and 51.3% in pregnant women. A 1978 study reported 69.1% prevalence in children 12-59 months (WHO database).

Mexico. The most recent survey (Mexico ENSANUT, 2006) examined 6,618 children aged 12–59 months, 20,610 nonpregnant women aged 12–49 years, and 525 pregnant women. The overall prevalence of anemia was found to be 23.7% in children aged 12–59 months (22.4% urban, 25.4% rural), 15.5% in nonpregnant women, and 20.6% in pregnant women. A national nutrition survey was conducted in 1999; the reported prevalence of anemia was 29.8% in children 12–59 aged months (Mexico, 2001).

Nicaragua. The most recent national data are contained in a household survey undertaken during 2003–05 as part of the Integrated Nutritional Surveillance System (SIVIN) of the Ministry of Health (Nicaragua, 2007). The survey covered a representative sample of 1,466 children aged 6–59 months and 1,246 nonpregnant women. Overall anemia rates were found to be 20.1% (16.3% urban, 24.9% rural) for children aged 6–59 months (estimated 18.1% for children 12–59 months) and 11.2% (13% urban, 9% rural) for nonpregnant women aged 15–49 years. Pregnant women were not covered. The first national micronutrient survey was carried out in 1993; reported anemia rates amounted to 28.5% in children aged 12–59 months and 33.6% in nonpregnant women (Nicaragua, 1994).

Panama. The most recent national survey on anemia was carried out in 1999. It involved a sample of 1,010 children aged 12–59 months, 1,523 nonpregnant women, and 143 pregnant women. The overall anemia prevalence amounted to 36.0% in children, 40.3% in nonpregnant women, and 36.4% in pregnant women (Panamá, 1999–2000). The finding that there was a higher prevalence in nonpregnant than in pregnant women is questionable. A 1992 national study reported 18.6% and 28.8% prevalence of anemia in children aged 12–59 months and pregnant women, respectively, whereas a similar study completed in 1995 reported a 32.9% prevalence in nonpregnant women (cited in Panama, 1999–2000).

Peru. The most recent national DHS (ENDES continua 2009) involved a sample of 7,680 children aged 6–59 months, 21,908, nonpregnant women aged 15–49 years, 906 pregnant women and 2,974 lactating women, (Peru ENDES, 2010). The reported prevalence was 37.2% for children aged 6–59 months (33.2% urban, 44.1% rural, 38.3% males, 36.0% females, estimated 33.4% for 12–59 months), 20.2% for nonpregnant women, 26.6% for pregnant women and 24.5 for lactating women. The prevalence of anemia was 20.7% for urban and 22.1% for rural women (including pregnant and lactating). The 2004 ENDES (Peru ENDES, 2005), reported a prevalence of anemia of 46.2% for children aged 6-59 months and 28.6% for nonpregnant women. ‘

Table 1. Prevalence of anemia reported from nationally representative samples of preschool children, selected LAC countries, most recent data available

Population group	Antigua & Barbuda 1996	Argentina 2005	Belize 1994/95*	Bolivia ENDSA 2008	Chile ENS 2003	Colombia 2005	Costa Rica 1996	Cuba 1999	Dominica 1996	Dominican Rep. 2009	Ecuador 1997*
Age (months)	12–59	6–72	NR	6–59	NR	12–59	12–71	NR	12–59	6–59	6–59
Sample size	81	21,010	NR	2,552	NR	5,558	961	NR	157	772	1,083
Anemia prevalence (%)											
Full sample	49.4	16.5	NR	61.3	NR	33.2	26.3	NR	34.4	28.0	60.2
Urban	NR	19.0	NR	55.7	NR	30.8	26.0	NR	NR	25.0	55.2
Rural	NR	15.2	NR	67.6	NR	39.1	32.7	NR	NR	36.0	65.8
Male	47.7	NR	NR	63.7	NR	32.2	26.5	NR	NR	NR	60.6
Female	51.3	NR	NR	58.8	NR	34.2	26.2	NR	NR	NR	59.2
6–11 months	NR	47.6	NR	77.4 (E)	NR	NR		NR	NR	61.0	65.0
12–23 months	NR	28.9	NR	78.1 (E)	NR	53.2	37.2	NR	NR	37.0	75.9
24–35 months	NR	NR	NR	63.0	NR	33.0	24.2	NR	NR	27.0	64.6
36–47 months	NR	NR	NR	51.3	NR	25.4	16.6	NR	NR	21.0	55.8
48–59 months	NR	NR	NR	46.7	NR	22.1	10.2	NR	NR	14.0	44.2
6–59 months	NR	20.2 (E)	NR	61.3	NR	NR	NR	NR	NR	28.0	60.2
12–59 months	49.4	12.5 (E)	NR	59.8 (E)	NR	33.2	22.1 (E)	NR	34.4	24.8	59.8

* Results of a secondary analysis of the database by Humberto Mendez (INCAP).
E = Estimated from reported prevalence, assuming even distribution of population sample by age group.
NR = Not reported.

Table 1. Continued

Population group	El Salvador FESAL 2008	Guatemala ENSMI 2002	Guyana 1996/97*	Haiti 2005/06	Honduras ENDESA 2005/06	Jamaica 1997/98*	Mexico ESANUT 2006	Nicaragua SIVIN 2003/05	Panama 1999	Peru ENDES 2009
Age (months)	6–59	6–59	12–59	6–59	6–59	12–59	12–59	6–59	12–59	6–59
Sample size	3,836	4,016	140	2,599	8,649	272	6,618	1,466	1,010	7,680
Anemia prevalence (%)										
Full sample	26.0	39.7	47.9	60.6	37.3	48.2	23.7	20.1	36.0	37.2
Urban	23.4	35.2	NR	66.9	33.0	NR	22.4	16.3	NR	33.2
Rural	28.3	41.8	NR	57.5	40.0	NR	25.4	24.9	NR	44.1
Male	27.0	41.2	NR	62.6	38.6	59.2	NR	21.7	NR	38.3
Female	24.9	38.1	NR	58.8	35.9	39.5	NR	18.4	NR	36.0
6–11 months	46.1	65.3	NR	73.8	64.6 (E)	NR	NR	38.0	NR	73.6 (E)
12–23 months	33.4	55.6	NR	75.0	52.7 (E)	NR	37.8	29.4	52.5	54.8 (E)
24–35 months	26.1	38.5	NR	61.6	37.4	NR	25.7	16.4	39.7	34.0
36–47 months	18.4	30.1	NR	51.1	27.5	NR	20.1	15.6	29.8	25.6
48–59 months	14.7	21.4	NR	46.9	21.7	NR	14.2	10.7	23.9	19.2
6–59 months	26.0	39.7	NR	60.6	37.3	NR	NR	20.1	NR	37.2
12–59 months	22.9	36.4 (E)	47.9	59.9 (E)	34.3 (E)	48.2	23.7	18.1	36.0	33.4 (E)

* Results of a secondary analysis of the database by Humberto Mendez (INCAP).
E = Estimated from reported prevalence, assuming even distribution of population sample by age group.
NR = Not reported.

Table 2. Prevalence of anemia reported from nationally representative samples of women of childbearing age, selected LAC countries, most recent data available

Population group	Antigua & Barbuda 1996	Argentina 2005	Belize 1994/95*	Bolivia ENDSA 2008	Chile ENS 2003	Colombia 2005	Costa Rica 1996	Cuba 1999	Dominica 1996	Dominican Rep. 2009	Ecuador 1997**
Nonpregnant women											
Age (years)	NR	10–49	NR	15–49	17-44	13–49	15–44	18–40	NR	15-49	15–49
Sample size	NR	5,322	NR	5,704	731	3,851	820	3,222	NR	1,129	1,916
Prevalence (%)	NR	18.7	NR	34.9	4.8	32.8	18.6	15.5	NR	34.0	47.4
Urban	NR	NR	NR	36.0***	NR	33.2	17.4	NR	NR	34.0	44.4
Rural	NR	NR	NR	42.3***	NR	30.9	21.7	NR	NR	33.0	52.9
Pregnant women											
Sample size	NR	1,321	6,402	324	NR	667	68	3,217*	148	NR	130
Prevalence (%)	NR	30.5	51.7	49.4	NR	44.7	27.9	27.0	35.6	NR	56.9

Table 2. Continued

Population group	El Salvador FESAL 2008	Guatemala ENISMI 2002	Guyana 1996/97*	Haiti 2005/06	Honduras ENDESA 2005/06	Jamaica 1997/98*	Mexico ESANUT 2006	Nicaragua SIVIN 2003/05	Panama 1999	Peru ENDES 2009
Nonpregnant women										
Age (years)	15–49	15–49	15-49	15–49	15–49	NR	12–49	15–49	15–49	15–49
Sample size	3,633	3,062	447	4,945	17,323	NR	20,610	1,246	1,523	21,908
Prevalence (%)	9.6	20.2	53.9	45.5	18.6	NR	15.5	11.2	40.3	20.2
Urban	9.8	16.5	NR	50.9	18.3	NR	15.0	13.1	NR	20.7
Rural	9.5	22.2	NR	41.2	19.1	NR	16.0	8.6	NR	22.1
Pregnant women										
Sample size	296	541	269	290	1,042	343	525	NR	143	906
Prevalence (%)	7.5	22.1**	52.0	50.3	21.4	51.3	20.6	NR	36.4	26.6

* Compilation of antenatal records.
** Results of secondary analysis of the database by Humberto Mendez (INCAP).
*** Includes pregnant and lactating women.

Prevalence of anemia in preschool children

National prevalence rates for preschool children aged 6–59 months are available for 25 countries (five from the Mexico/Central America subregion, 10 from South America, and 10 from the Caribbean). The results are summarized in table 3 and figures 1 and 2. Preschool children from rural areas tend to have higher prevalence rates (Table 1). There is no consistent pattern by gender. The national prevalence of anemia in children aged 6–59 months ranges from 17.1% in Barbados to 61.3% in Bolivia. Anemia is a severe public health problem (prevalence above 40%) among children aged 6–59 months in four countries: Bolivia, Brazil, Ecuador, and Haiti. It is a moderate problem (20%–39.9%) in 19 countries, and a mild problem (5%–19.9%) in two countries: Barbados, and Uruguay (Map 1). The weighted average subregional prevalence reaches 33.9% in Mexico/Central America, 46.2% in South America, and 42.9% in the Caribbean. The total weighted prevalence is 44.5% in the 25 countries whose population of children aged 6–59 months (35.6 million) represents 70.5% of the 50.6 million children in this age group in the entire region.

Prevalence rates for children aged 12–59 months are available for 18 countries (seven in Mexico/Central America, six in South America, and five in the Caribbean). National prevalence ranges from 12.5% in Argentina to 59.9% in Haiti (table 3 and figure 3). Anemia prevalence is observed to be a severe public health problem among children aged 12–59 months in six countries (Antigua/Barbuda, Bolivia, Ecuador, Guyana, Haiti, and Jamaica). Anemia is a moderate problem in 10 countries and a mild problem in two countries (Argentina and Nicaragua). The weighted average prevalence for the 18 countries amounts to 30.6%. The subregional prevalence rates are 25.9% for Mexico/Central America, 33.5% for South America, and 42.9% for the Caribbean. The population of children aged 12–59 months in the 18 countries (25.5 million) represents 56.7% of the total 45 million in this age group in the region.

Table 3. Prevalence of anemia in preschool children aged 6-59 and 12-59 months, with subregional and regional prevalence estimates, selected LAC countries, most recent data available

Subregion and country	6–59 months		12–59 months	
	Sample size*	Prevalence (%)	Sample size*	Prevalence (%)
Mexico/Central America				
Belize		35.9 (WHO*)		
Costa Rica			794	22.1
El Salvador	3,836	26.0	3,349	22.9
Guatemala	4,016	39.7	3,574	36.4
Honduras	8,649	37.3	7,796	34.3
Mexico			6,618	23.7
Nicaragua	1,466	20.1	1,324	18.1
Panama			1,010	36.0
Subregional total and mean**	17,967	33.9**	24,465	25.9**

Table 3. Continued

Subregion and country	6–59 months		12–59 months	
	Sample size*	Prevalence (%)	Sample size*	Prevalence (%)
South America				
Argentina	17,190	20.2	15,280	12.5 (E)
Bolivia	2,552	61.3	2,277	59.8 (E)
Brazil		54.9 (WHO**)		
Chile		24.4 (WHO*)		
Colombia			5,558	33.2
Ecuador	1,083	60.2	1,003	59.8
Guyana			140	47.9
Paraguay		30.2 (WHO*)		
Peru	7,680	37.2	6,865	33.4 (E)
Suriname		25.7 (WHO*)		
Uruguay		19.1 (WHO*)		
Venezuela		33.1 (WHO*)		
Subregional total and mean**	28,505	46.2**	31,123	33.5**
Caribbean				
Antigua & Barbuda			81	49.4
Bahamas		21.9 (WHO*)		
Barbados		17.1 (WHO*)		
Cuba		26.7 (WHO*)		
Dominica			157	34.4
Dominican Republic	772	28.0	694	24.8
Grenada		32.0 (WHO*)		
Haiti	2,599	60.6	2,324	59.9 (E)
Jamaica			272	48.2
St. Kitts & Nevis		22.9 (WHO*)		
St. Lucia		32.2 (WHO*)		
St. Vincent & Grenadines		32.3 (WHO*)		
Trinidad & Tobago		30.4 (WHO*)		
Subregional total and mean**	3,371	42.9**	3,528	42.9**
Total regional sample and mean prevalence**	**49,843**	**44.5****	**59,116**	**30.6****

WHO* Estimated by WHO based on regression equation.
WHO** Estimated by WHO as the average prevalence of subnational studies in 1993, 1997, and 1998.
* Except for WHO estimates.
** Weighted by the mid-2005 estimated population of children in each country, by age group.
E=estimated from data in report.

Figure 1. Anemia prevalence in children 6-59 months, by country and for LAC as a whole, various years

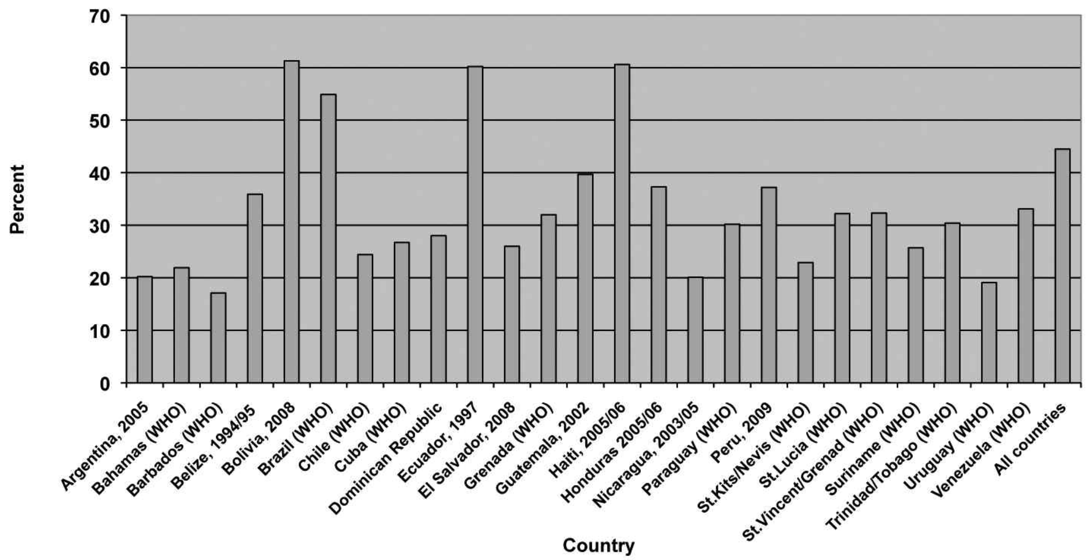
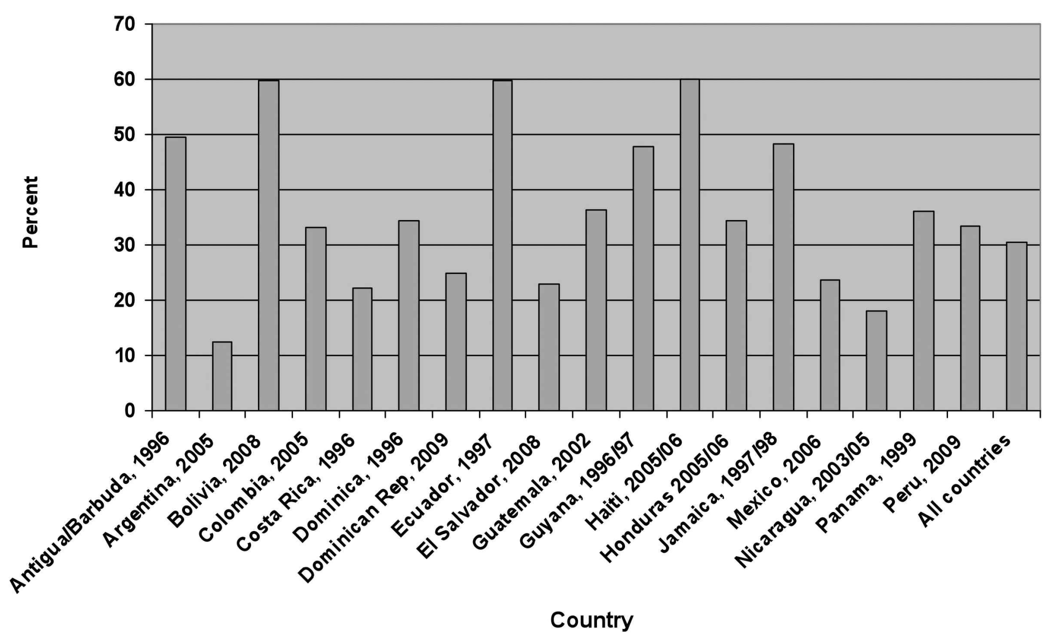
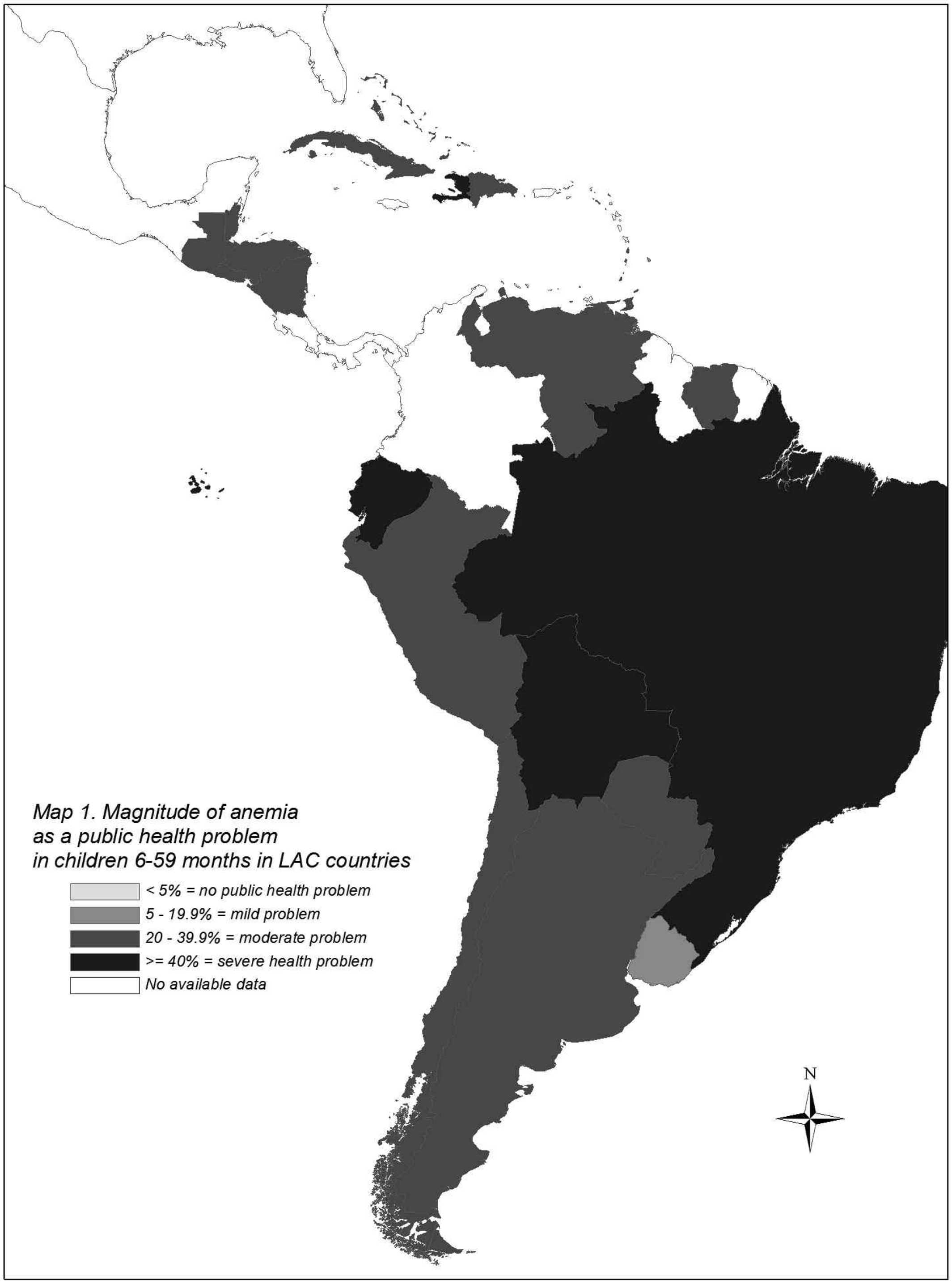


Figure 2. Anemia prevalence in children 12-59 months, by country and for LAC as a whole, various years



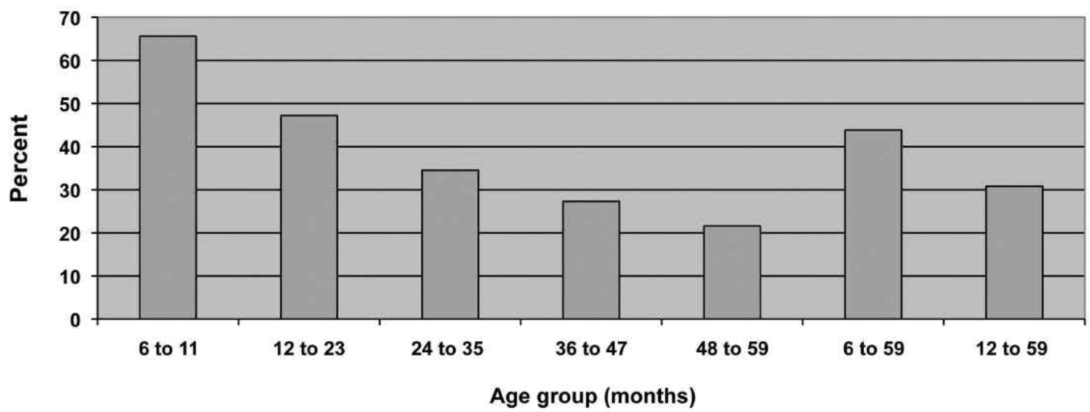
Map1. Magnitude of anemia as a public health problem in children 6-59 months in LAC countries



A higher prevalence of anemia was detected in children aged 6–59 months than in children aged 12–59 months. This appears to be the result of consistently higher prevalence rates in the group aged 6–11 months, as seen in table 3. No data are available on anemia prevalence rates among infants under 6 months of age. These infants are presumed to be at lower risk of anemia because of the protection conferred by breastfeeding. Moreover, an internationally accepted hemoglobin cutoff has not yet been established for this age group.

Figure 3 presents estimated prevalence rates of anemia for children aged 6–59 months, broken down by yearly age group for 15 countries. Unfortunately, some country reports did not present prevalence rates disaggregated by all yearly age groups. National prevalence rates of anemia for the group aged 6–11 months were available for only 11 countries. The rates are extremely high, ranging from 38.0% in Nicaragua to 77.4% in Bolivia. Prevalence rates decline with age: 38.0–77.4% at 6–11 months, 28.9–75.9% at 12–23 months, 16.4–64.6% at 24–35 months, 15.6–55.8% at 36–47 months, and 10.2%–46.9% at 48–59 months. Bolivia, Ecuador, Haiti, and Peru tend to have the highest rates across age groups. The average prevalence (weighted by the estimated number of children by age group for countries with disaggregated data available) confirms the declining trend in prevalence with age: 65.6% at 6–11 months, 47.2% at 12–23 months, 34.5% at 24–35 months, 27.3% at 36–47 months, and 21.6% at 48–59 months.

Figure 3. Anemia prevalence in children 6-59 months, by age group, in LAC, various years



Prevalence of anemia in women of childbearing age

Prevalence rates of anemia in women of childbearing age are available for 32 countries (eight in Mexico/Central America, 12 in South America, and 12 in the Caribbean). The results are summarized in table 4 and figures 4 and 5. The prevalence of anemia among nonpregnant women of childbearing age ranges from 4.8% in Chile to 53.9% in Guyana. In four countries (Ecuador, Guyana, Haiti, and Panama), anemia is a severe public health problem. It is a moderate public health problem in 18 countries and a mild public health problem in 10 countries (map 2). There is a tendency for higher prevalence rates in rural areas than in urban areas (table 2). The average prevalence of anemia in the 32 countries, weighted by the estimated number of nonpregnant women in each country, amounts to 22.5% (16.3% in Mexico/Central America, 24.2% in South America, 29.0% in the Caribbean).

With respect to pregnant women, the national prevalence of anemia in 32 countries ranges from 7.5% in El Salvador to 56.9% in Ecuador (table 4 and figure 5). Anemia in this group is a severe public health problem in seven countries (Belize, Bolivia, Colombia, Ecuador, Guyana, Haiti, and Jamaica) and a moderate threat in 24 countries. Only in El Salvador is anemia a mild problem (map 3). A tendency toward higher rates in rural areas can be seen (table 2). The weighted average for the 32 countries reaches 30.9% (21.3% in Mexico/Central America, 34.5% in South America, and 42.5% in the Caribbean). The most recent study in Guatemala used the CDC's hemoglobin reference values by month of pregnancy (CDC, 1997).

Table 4. Prevalence of anemia in non pregnant women of childbearing age and pregnant women, and subregional and regional estimates, selected LAC countries, most recent data available

Subregion and country	Nonpregnant women		Pregnant women	
	Sample size	Prevalence (%)	Sample size	Prevalence (%)
Mexico/Central America				
Belize		31.2 (WHO*)	6,402	51.7
Costa Rica	820	18.6	68	27.9
El Salvador	3,633	9.6	296	7.5
Guatemala	3,062	20.2	541	22.1
Honduras	17,323	18.6	1,042	21.4
Mexico	20,610	15.5	525	20.6
Nicaragua	1,246	11.2		32.9 (WHO*)
Panama	1,523	40.3	143	36.4
Subregional total and mean*	48,217	16.3*	9,017	21.3*
South America				
Argentina	5,322	18.7	1,321	30.5
Bolivia	5,704	34.9	324	49.4
Brazil		23.1 (WHO**)		29.1 (WHO**)
Chile	731	4.8		28.3 (WHO*)
Colombia	3,851	32.8	667	44.7
Ecuador	1,916	47.4	130	56.9
Guyana	447	53.9	269	52.0
Paraguay		26.2 (WHO*)		39.3 (WHO*)
Peru	21,908	20.2	906	26.6
Suriname		20.4 (WHO*)		32.4 (WHO*)
Uruguay		16.9 (WHO*)		27.1 (WHO*)
Venezuela		27.3 (WHO*)		39.6 (WHO*)
Subregional total and mean*	39,879	24.2*	3,617	34.5*
Caribbean				
Bahamas		22.7 (WHO*)		23.3 (WHO*)
Barbados		17.2 (WHO*)		23.0 (WHO*)
Cuba	3,222	15.5	3,217	27.0
Dominica		23.7 (WHO*)	148	35.6
Dominican Republic	1,129	34.0		39.9 (WHO*)
Grenada		24.0 (WHO*)		31.4 (WHO*)
Haiti	4,945	45.5	290	50.3
Jamaica		23.8 (WHO*)	343	51.3
St. Kitts & Nevis		20.8 (WHO*)		25.6 (WHO*)
St. Lucia		25.0 (WHO*)		33.4 (WHO*)
St. Vincent & Grenadines		24.1 (WHO*)		32.7 (WHO*)
Trinidad & Tobago		24.3 (WHO*)		29.7 (WHO*)
Subregional total and mean*	9,296	29.0*	3,998	42.5*
Total sample (except WHO estimates) and mean prevalence*	**97,392**	**22.5***	**16,632**	**30.9***

* Weighted by the estimated population of women 15–49 years by country.
WHO* Estimated by WHO based on regression equation.
WHO** Estimated by WHO based on subnational data from 1993, 1997, and 1998.

Figure 4. Anemia prevalence in non pregnant women of child-bearing age, by country and for LAC as a whole, various years

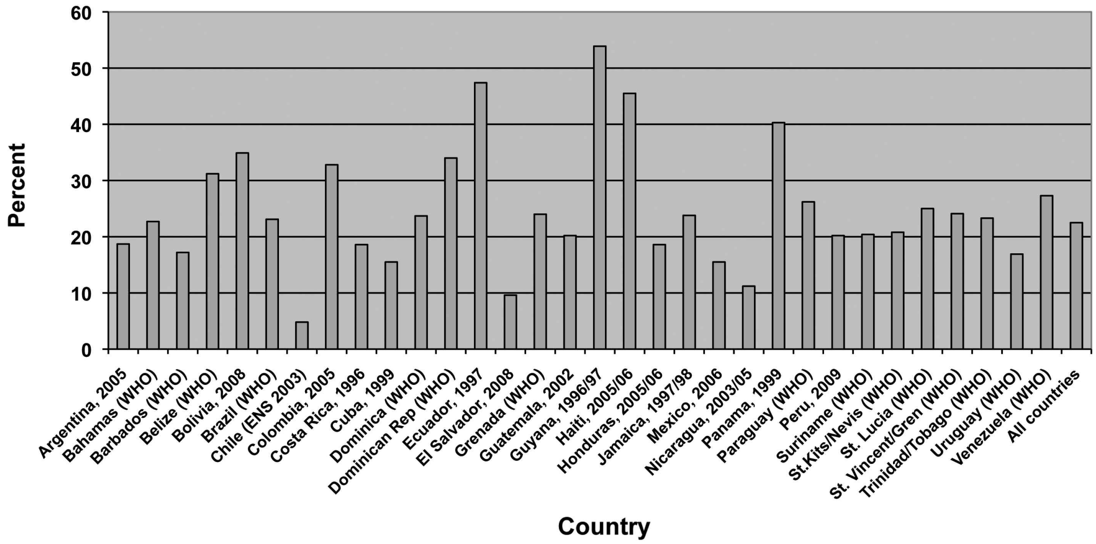
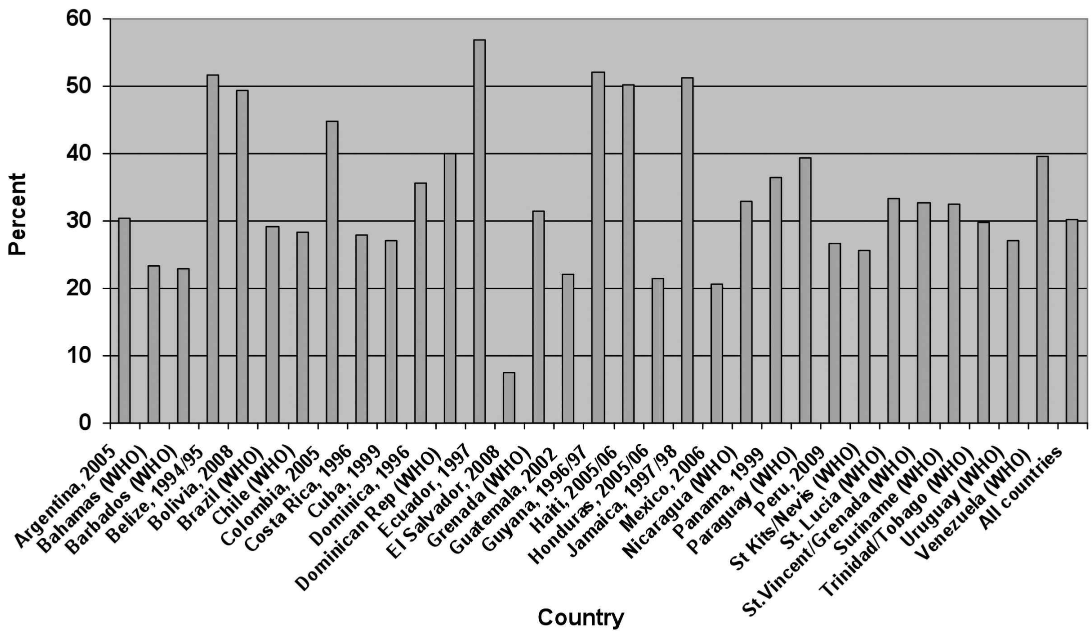
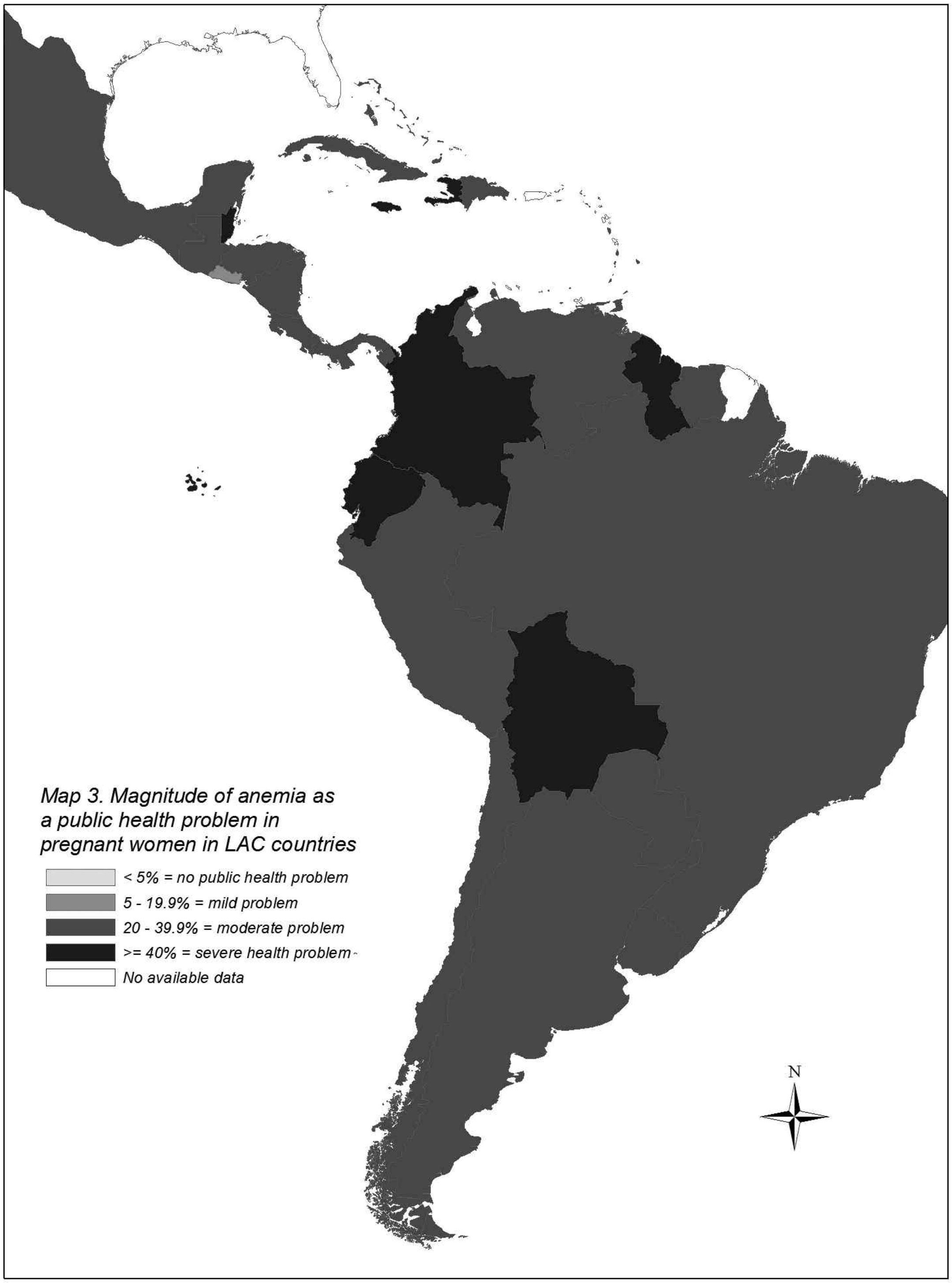


Figure 5. Anemia prevalence in pregnant women, by country and for LAC as a whole, various years



Map 2. Magnitude of anemia as a public health problem in non pregnant women in LAC countries

Map 3. Magnitude of anemia as a public health problem in pregnant women in LAC countries



Trends in the prevalence of anemia

Table 5 and figure 6 present national and regional trends with respect to the prevalence of anemia among preschool children aged 12–59 months in 16 countries. Nine of the 16 countries with repeated national prevalence estimates show declining rates. However, with the exception of four countries (Jamaica, Peru, Dominica, and Nicaragua, where the decrease was more than 25% of the baseline), the decline is relatively small in terms of percentage points per year. The remaining six countries (Bolivia, Colombia, Ecuador, Guatemala, Guyana, Honduras and Panama) experienced increased prevalence of anemia. The largest increase was seen in Ecuador (37.5 percentage points or 168% of the baseline rate in the 11-year period 1986–97 or 3.5 percentage points per year). The overall weighted average prevalence for the 15 countries was found to be 34% at baseline and 32.9% in the last survey. These results indicate practically no change in anemia rates over an average period of 12.1 years. Estimates are derived from the oldest and more recent prevalence reports available from each country. The exception is Jamaica; the baseline rate for this country was quoted from Mason et al, 2005.

Prevalence rates from repeated surveys are available for nonpregnant women from 11 countries (table 6 and figure 7). In eight of the 11 countries, there was a decline in prevalence of anemia. The largest drops were seen in Nicaragua, Peru, Guatemala, Haiti and Honduras. In contrast, increases in the prevalence rates were observed in Bolivia, Colombia, and Panama. The baseline weighted average prevalence amounted to 20.3%, compared to 21.1% in the most recent studies. There was an overall increase of 0.8% (3.9% of the baseline rate) in an average nine-year period, that is, 0.1 percentage points per year. The baseline rate for Costa Rica was quoted from Mason et al. (2005), whereas those for El Salvador, Guatemala, Honduras, Mexico, and Panama were abstracted from the WHO database.

Table 5. Trends in the prevalence of anemia in preschool children aged 12–59 months, selected LAC countries, by study period

Country, years	Baseline (%)	Most recent (%)	Interval (years)	Change (% points)		
				Total	% baseline	Per year
Antigua & Barbuda, 1985–1996	55.0	49.4	11	-5.6	-10.2	-0.5
Bolivia, 1998–2008	55.6	59.8	10	4.2	7.6	0.4
Colombia, 1995–2005	23.3	33.2	10	9.9	42.5	1.0
Dominica, 1985-1996	46.0	34.4	11	-11.6	-25.2	-1.1
Domincan Republic 1993-2009	32.0	24.8	16	-7.2	-22.5	-0.5
Ecuador, 1986–1997	22.3	59.8	11	37.5	168.2	3.4
El Salvador, 1988–2008	23.2	22.9	20	-0.3	-1.3	0.0
Guatemala, 1995–2002	25.9	36.4	7	10.5	40.5	1.5
Guyana, 1971–1997	41.0	47.9	26	6.9	16.8	0.3
Haiti, 2000–2006	63.1	59.9	6	-3.2	-5.1	-0.5
Honduras, 1996–2005	33.4	34.3	9	0.9	2.7	0.1
Jamaica, 1978–1997	69.1*	48.2	19	-20.9	-30.2	-1.1
Mexico, 1999–2006	29.8	23.7	7	-6.1	-20.5	-0.9
Nicaragua, 1993–2003/5	28.5	18.1	11	-10.4	-36.5	-0.9
Panama, 1992–1999	18.6	36.0	7	17.4	93.5	2.5
Peru, 1996–2009	56.7	33.4	13	-23.3	-41.1	-1.8
All countries	**34.0****	**32.9****	**12.1**	**-1.1**	**-3.2**	**-0.1**

* Source: Mason et al, 2005
** Weighted by the relative proportion of children 12–59 months (6–59 in Bolivia) by country (mid-2005).

Table 6. Trends in the prevalence of anemia in nonpregnant women of childbearing age, selected LAC countries, by study period

Country, years	Baseline (%)	Most recent (%)	Interval (years)	Change (% points)		
				Total	% baseline	Per year
Bolivia, 1998–2008	27.1	34.9	10	7.8	28.8	0.8
Colombia, 1995–2005	22.5	32.8	10	10.3	45.8	1.0
Costa Rica, 1989–1996	22.0*	18.6	7	-3.4	-15.5	-0.5
El Salvador, 1978–2008	13.0**	9.6	30	-3.4	-26.2	-0.1
Guatemala, 1995–2002	34.9**	20.2	7	-14.7	-42.1	-2.1
Haiti, 2000–2006	54.4	45.5	6	-8.9	-16.4	-1.5
Honduras, 1996–2005	25.8**	18.6	9	-7.2	-27.9	-0.8
Mexico, 1999–2006	20.0**	15.5	7	-4.5	-22.5	-0.6
Nicaragua, 1993–2003/5	33.6	11.2	11	-22.4	-66.7	-2.0
Panama, 1995–1999	32.9**	40.3	4	7.4	22.5	1.9
Peru, 1996–2009	35.8	20.2	13	-15.6	-43.6	-1.2
All countries	**20.3*** **	**21.1*** **	**10.4**	**0.8**	**3.9**	**0.1**

* Source: Mason et al. 2005.
** Source: WHO-VMNIS.
*** Weighted by the relative proportion of nonpregnant women 15–49 years by country (mid-2005).

Table 7. Trends in the prevalence of anemia in pregnant women, selected LAC countries, by study period

Country, years	Baseline rate (%)	Most recent rate (%)	Interval (years)	Change in % points		
				Total	% baseline	Per year
Belize, 1984–1995	49.3*	51.7	11	2.4	4.9	0.2
Bolivia, 1998–2008	27.9**	49.4	10	21.5	77.1	2.2
Costa Rica, 1989–1996	28.0*	27.9	7	-0.1	-0.4	0.0
Cuba, 1985–1999	14.0*	27.0	14	13.0	92.9	0.9
Dominica, 1988–1996	24.7	35.6	8	10.9	44.1	1.4
Ecuador, 1985–1996	17.0*	56.9	11	39.9	234.7	3.6
El Salvador, 1978–2008	13.8**	7.5	30	-6.3	-45.7	-0.2
Guatemala, 1995–2002	39.1**	22.1	7	-17.8	-45.5	-2.4
Guyana, 1984–1997	71.0	52.0	13	-19.0	-26.8	-2.2
Haiti, 2000–2006	63.2	50.3	6	-12.9	-20.4	-2.2
Honduras, 1996–2005	32.4**	21.4	9	-11.0	-34.0	-1.2
Jamaica, 1978–1997	61.6**	51.3	19	-10.3	-16.7	-0.5
Mexico, 1999–2006	26.2**	20.6	7	-5.6	-21.4	-0.8
Panama, 1992–1999	28.8	36.4	7	-2.5	-26.4	-1.1
Peru, 1996–2009	35.2**	26.6	13	-8.6	-24.4	-0.9
All countries	**43.2*** **	**28.1*** **	**11.5**	**-15.1**	**-34.7**	**-1.3**

* Source: Mason et al., 2005.
** Source: WHO-VNMIS.
*** Mean prevalence weighted by the relative proportion of pregnant women by country (mid-2005).

Figure 6. Trends in anemia prevalence in children 12-59 months, by country and for LAC as a whole, various years

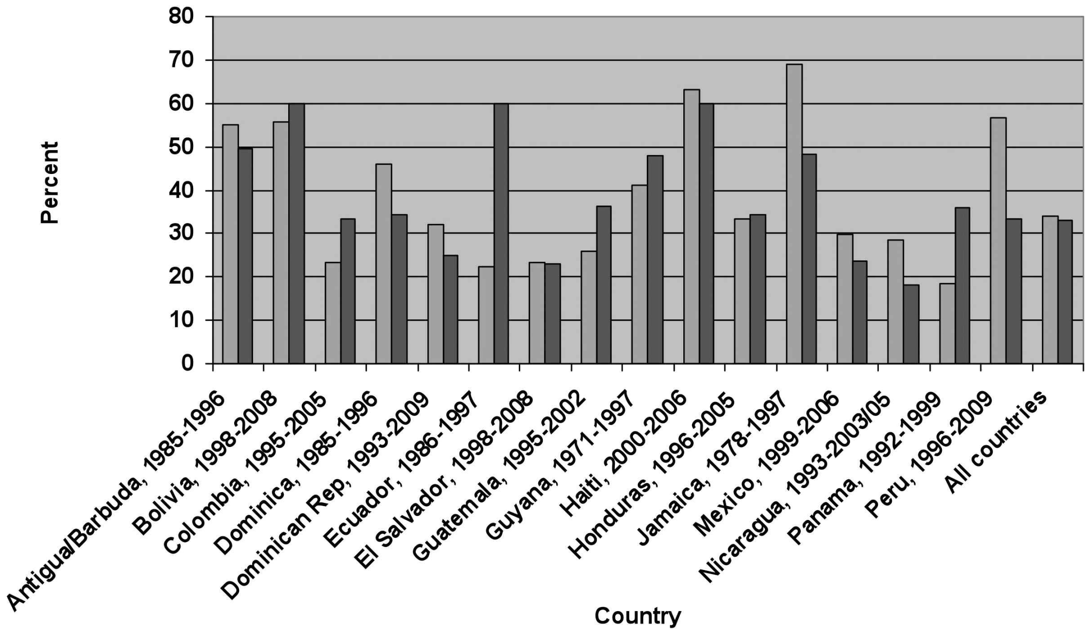


Figure 7. Trends in anemia prevalence in non pregnant women of child-bearing age, by country and for LAC as a whole, by study period

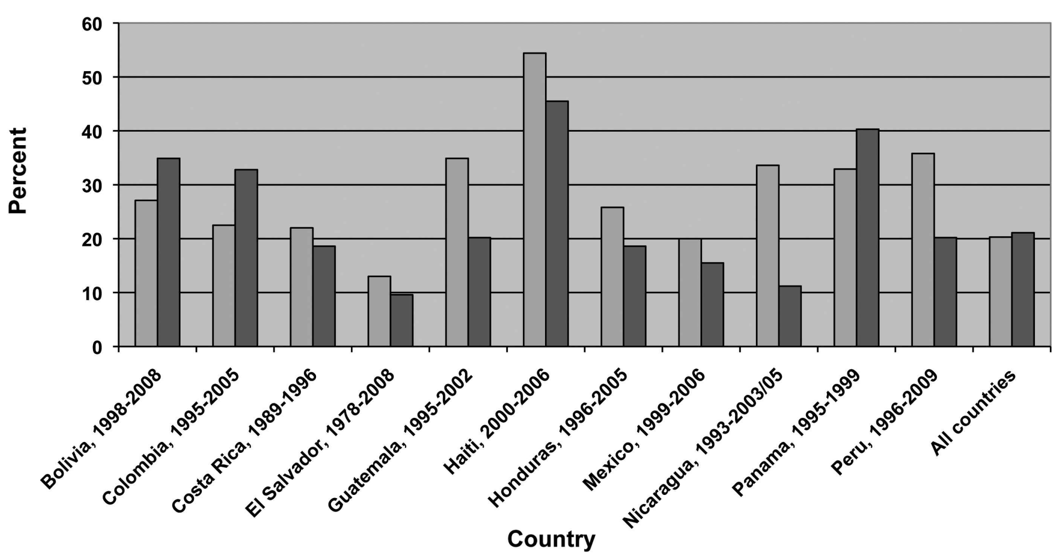
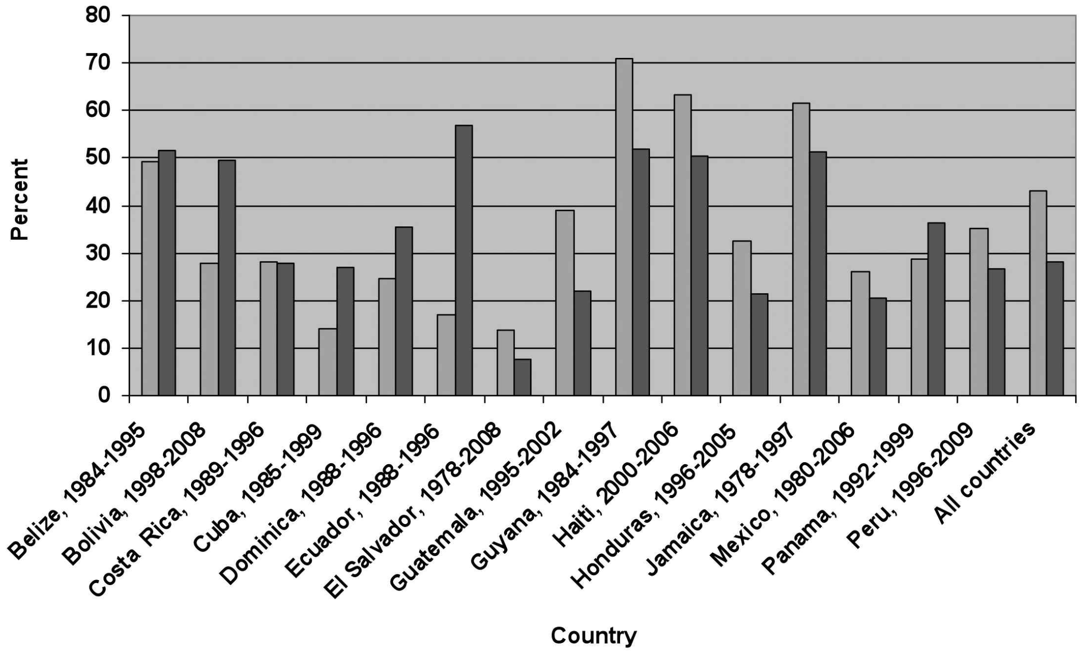


Figure 8. Trends in anemia prevalence in pregnant women, by country and for LAC as a whole, by study period



Prevalence rates of anemia among pregnant women declined in 10 of the 15 countries with repeated surveys (table 7 and figure 8). The most significant decline in percentage points per year (>20%) occurred in El Salvador, Guatemala, Guyana, Haiti, Honduras, Mexico, Panama and Peru. The prevalence rate increased in Belize, Bolivia, Cuba, Dominica, and Ecuador; the latter and Cuba having the highest increase (234.7% and 92.9% of the baseline, respectively). The baseline weighted mean prevalence for the 15 countries was 43.2%, but the most recent reports indicate a prevalence rate of 28.1%. The results show a significant drop in prevalence rates: 15.1 percentage points (34.7% of baseline) in an average 11.5-year period, at a rate of 1.3 percentage points per year. Baseline rates for pregnant women from four countries were quoted from Mason et al. (2005), and those from seven countries from the WHO database.

Estimated numbers of anemic children and women

Tables 8 and 9 present the prevalence of anemia in preschool children and in women of childbearing age, by country and subregion, as well as subregional and regional estimates of the size of the population affected. To estimate the magnitude of the population affected by mid-2005 in 25 countries for children aged 6–59 months and in 18 countries for children aged 12–59 months, we used the most recent prevalence of anemia in children, including WHO estimates for countries without national anemia assessments (table 8).

The weighted average prevalence of anemia in children aged 6–59 months amounts to 44.5% (33.9% for Mexico/Central America, 46.2% for South America, and 42.9% for the Caribbean). Of the 35.6 million children in the 25 countries, 15.9 million are estimated to be affected by anemia. Children aged 6–59 months in the 25 countries account for 70.5% of the total number of children of this age group in the region. If the weighted average prevalence of 44.5% for children aged 6–59 months in the 25 countries is applied to the total 50.6 million children of this age in the region, the total estimated number of anemic children would be about 22.5 million. Subregional prevalence estimates for anemia children aged 6-59 months would be expected to be more robust for the South America region, as they are derived from 10 of 13 countries with 28.8 million children of 87.5% of the total of the sub-region, and for the Caribbean from 10 of 17 countries with about 3 million children or 85.7% of the total 3.5 million in the sub-region. By contrast, prevalence estimates for Mexico/Central America are derived from five of eight countries (with a population of 4 million children or 28.2% of the total 14.2 million children in the sub-region).

The estimated total number of anemic children aged 12–59 months in 18 countries is 7.8 million of the total 25.5 million children in this age range (table 8), with a weighted average prevalence rate of 30.6%. In Mexico/Central America, the estimated number of anemic children is 3.3 million (25.9%). In South America, an estimated 3.6 million children (33.5%) are anemic. In the Caribbean, the number of anemic children is estimated to be 1 million (42.9%). If the 30.6% weighted average prevalence rate for children in the 18 countries is extrapolated to all children in the region, the total number of anemic children of this age would be about 13.8 million. Of note is that children aged 12–59 months (25.5 million) in the 18 countries represent about 56.7% of the 45 million children in this age group in the whole region. Estimates for Mexico/Central America would be expected to be more robust, as they are based on data from seven of eight countries (all except Belize, which has only 300,000 inhabitants), covering 12.56 million children aged 12–59 months or nearly 100% of the 12.59 million in the subregion. Estimates for South America are based on data from six of 13 countries with a population of 10.7 million children aged 12–59 months, or about 36.5% of the total 29.3 million in the subregion. Estimates for the Caribbean are based on five countries with a total population of 2.2 million children aged 12–59, or 68.7% of the population for the subregion. In general, the regional estimate is likely to be more robust for children aged 6–59 months (based on data from 25 countries) than for children aged 12–59 months (data from 18 countries).

Table 8. Estimated population of anemia in preschool children, by country and with subregional and regional estimates, most recent data available

Subregion and country	Children 6–59 months			Children 12–59 months		
	Total number (1,000s)	Prevalence (%)	Estimated anemic (1,000s)	Total number (1,000s)	Prevalence (%)	Estimated anemic (1,000s)
Mexico/Central America						
Belize	33	35.9	12			
Costa Rica				314	22.1	69
El Salvador	700	26.0	182	622	22.9	142
Guatemala	1,833	39.7	728	1,629	36.4	593
Honduras	846	37.3	316	752	34.3	258
Mexico				8,435	23.7	1,999
Nicaragua	605	20.1	122	538	18.1	97
Panama				274	36.0	99
Subregional total and mean*	4,017	33.9	1360	12,564	25.9	3,257
South America						
Argentina	3,006	20.2	607	2,672	12.5	334
Bolivia	1,115	61.3	683	991	59.8	593
Brazil	16,238	54.9	8,915			
Chile	1,114	24.4	272			
Colombia				3,585	33.2	1,190
Ecuador	1,283	60.2	772	1,140	59.8	682
Guyana				61	47.9	29
Paraguay	656	30.2	198			
Peru	2,540	37.2	945	2,258	33.4	754
Suriname	41	25.7	11			
Uruguay	232	19.1	44			
Venezuela	2,576	33.1	853			
Subregional total and mean*	28,801	46.2	13,300	10,707	33.5	3,582
Caribbean						
Antigua & Barbuda				8	49.4	4
Bahamas	25	21.9	5			
Barbados	16	17.1	3			
Cuba	602	26.7	161			
Dominica				8	34.4	3
Dominican Republic	923	28	321	991	24.8	246
Grenada	10	32.0	3			
Haiti	1,115	60.6	676	991	59.9	594
Jamaica				223	48.2	107
St. Kitts & Nevis	5	22.9	1			
St. Lucia	14	32.2	5			
St. Vincent & Grenadines	11	32.3	4			
Trinidad & Tobago	83	30.4	25			
Subregional total & mean*	2,804	42.9	1,204	2,221	42.9	954
Total population and mean prevalence*	**35,622**	**44.5**	**15,265**	**25,492**	**30.6**	**7,793**

* Weighted by the mid-2005 estimated population of children by country and age group.

The estimated anemic populations of nonpregnant women in 32 countries (eight in Mexico/Central America, 12 in South America, and 12 in the Caribbean) are shown in table 9. These countries have a combined population of about 139.7 million nonpregnant women of childbearing age (15–49 years). Overall, 22.5% of about 31.4 million non pregnant women are anemic. There is a subregional prevalence of 16.3% in Mexico/Central America (5.8 million women affected), 24.2% in South America (23.0 million women affected), and 29.0% in the Caribbean (2.6 million women affected). If the weighted mean prevalence of anemia in the 32 countries covered (22.5%) is applied to the 141.1 million nonpregnant women aged 15–49 years in the LAC region as a whole, the total number of anemic nonpregnant women would be 31.7 million. The number of nonpregnant women of childbearing age in the 32 countries represents nearly 99% of the total in the region.

Table 9 also illustrates the estimated number of anemic pregnant women in the 32 countries. Data are provided for about 11.3 million pregnant women (3.5 million in eight countries of the Mexico/Central America subregion, nearly 7 million in 12 countries of South America, and 0.8 million in 12 Caribbean countries). In these 32 countries, 3.5 million pregnant women (30.9% of the total number of pregnant women) are estimated to be anemic: 0.8 million (21.3%) in Mexico/Central America, 2.4 million (34.5%) in South America, and 0.3 million (42.5%) in the Caribbean. If the weighted prevalence rate of the 32 countries (30.9%) is applied to the total 11.4 million pregnant women in the entire region, the estimated population of anemic pregnant women would be about 3.5 million. The population of pregnant women (11.3 million) in the 32 countries represents more than 99% of the total number of pregnant women in the region; countries with no data include French Guiana in South America and five Caribbean countries, with an estimated total of 85,000 pregnant women.

Three recent regional estimates of the prevalence of anemia and total population affected are shown in table 10: Mason et al. (2005) for the period 1990–2003, McLean et al. (2007) for 1993–2005, and our estimates for 1993–2009. Although there are some differences in the reference periods and in the number of countries covered, the three estimates do not differ significantly. Our estimates of the regional prevalence of anemia and the affected population in LAC are within the 95% confidence intervals provided by McLean et al., with the exception of the prevalence in preschool children (McLean's estimates are for 0.00–4.99 years).

Our prevalence and population affected estimates, based on the most recently available data from large numbers of countries, are closer to Mc Lean et al. estimates than those be Mason et al. We are reporting overall regional anemia rates of 44.5%, 22.5% and 30.9% for preschool children, non pregnant women of childbearing age and pregnant women, respectively. A total of 56.9 million preschool children and women 15-49 years have anemia; 22.5, 31.7 and 3.5 million for preschool children, non pregnant women of childbearing age and pregnant women, respectively.

Table 9. Estimated population of anemia in non pregnant and pregnant women, 15-49 years, by country and with subregional and regional estimates, most recent data available

Subregion and country	Nonpregnant women			Pregnant women		
	Total (1,000)*	Prevalence (%)	Estimated anemic (1,000s)	Total (1,000s)**	Prevalence (%)	Estimated anemic (1,000s)
Mexico/Central America						
Belize	67	31.2	21	8	51.7	4
Costa Rica	1,107	18.6	206	76	27.9	21
El Salvador	1,640	9.6	157	179	7.5	13
Guatemala	3,012	20.2	608	444	22.1	98
Honduras	1,642	18.6	305	218	21,4	47
Mexico	26,113	15.5	4,048	2,366	20.6	487
Nicaragua	1,324	11.2	148	163	32.9	54
Panama	810	40.3	326	73	36.4	27
Subregional total and mean*	35,715	16.3	5,820	3,527	21.3	751
South America						
Argentina	9,971	18.7	1,865	728	30.5	222
Bolivia	2,201	34.9	768	292	49.4	144
Brazil	47,957	23.1	11,078	3,085	29.1	898
Chile	4,206	4.8	202	270	28.3	76
Colombia	11,329	32.8	3,716	926	44.7	414
Ecuador	3,204	47.4	1,519	364	56.9	207
Guyana	185	53.9	100	17	52.0	9
Paraguay	1,474	26.2	386	134	39.3	53
Peru	6,898	20.2	1,393	533	26.6	142
Suriname	113	20.4	23	10	32.4	3
Uruguay	874	16.9	148	53	27.1	14
Venezuela	6,727	27.3	1,836	550	39.6	218
Subregional total and mean*	95,139	24.2	23,034	6962	34.5	2400
Caribbean						
Bahamas	85	22.7	19	3	23.3	1
Barbados	76	17.2	13	4	23.0	1
Cuba	2,996	15.5	464	130	27.0	35
Dominica	25	23.7	6	2	35.6	1
Dominican Republic	2,359	34.0	802	225	39.9	90
Grenada	27	24.0	6	2	31.4	1
Haiti	2,186	45.5	995	343	50.3	173
Jamaica	686	23.8	163	53	51.3	27
St.Kitts & Nevis	13	20.8	3	1	25.6	
St. Lucia	41	25.0	10	3	33.4	1
St. Vincent & Grenadines	30	24.1	7	2	32.7	1
Trinidad & Tobago	343	24.3	83	19	29.7	6
Subregional total and mean*	8,867	29.0	2,573	787	42.8	335
Total population and mean prevalence*	**139,721**	**22.5**	**31,427**	**11,276**	**30.9**	**3,486**

Table 10. Recent regional estimates of the prevalence of anemia in preschool children and women aged 15-49 years and the proportion afffected by anemia in LAC

Population group	Mason et al. 1990–2003	McLean et al. 1993–2005	Our estimates 1993–2009
Preschool children			
Number of countries	15	15	25
% prevalence (95% CI)	47.2*	39.5 (36.0–43.0)**	44.5**
Population affected (millions) (95% CI)	19.2	22.3 (20.3–24.3)	22.5
Nonpregnant women 15–49 years			
Number of countries	13	12	32
% prevalence (95% CI)	32.5*	23.5 (15.9–31.0)**	22.5**
Population affected (millions)	31.0	33.0	31.7
Pregnant women			
Number of countries	21	14	32
% prevalence (95% CI)	39.7*	31.1 (21.8–40.4)**	30.9**
Population affected (millions) (95% CI)	4.7	3.6 (2.5–4.7)	3.5

* Mean prevalence weighted by subregion

** Mean prevalence weighted by cou

BOX 2

Highlights of the Anemia Situation in LAC

√ Preschool children have the highest prevalence rates of anemia

√ A total of 57.7 million preschool children and women of reproductive age are estimated to be anemic

√ Prevalence rates are not decreasing, except among pregnant women

Prevalence of iron deficiency, iron deficiency anemia, and folate deficiency

The present review includes a small number of studies that assessed serum ferritin as an indicator of iron deficiency in eight countries. Most of these studies were part of national anemia surveys. A summary of the results of the studies follows and data are summarized in table 11. In some cases, information was abstracted from the 2002 Micronutrient Initiative (MI) report (García-Casal 2002).

Antigua and Barbuda. The 1997 study covered 81 children aged 12–59 months and reported a 49.4% prevalence of anemia. The study also found 5.7% of the children with SF <12 µg/dL and 22.7% with SF <24 µg/dL. ID was defined as SF <24 µg/dL. IDA prevalence was reported to be 13.3%, that is, 27% of the anemic children.

Argentina. In the 2005 national survey, SF was assessed in 5,730 children aged 6–23 months and ID was defined as SF <12 µg/dL in those with leucocytes 6,000–15,000 per ml or SF <30 µg/dL in those with leucocytes >15,000 per ml (Koga et al. 2008). Reported anemia prevalence was 34.1%, whereas ID and IDA rates were 34.3% and 18.6% (54% of the anemic children), respectively. Anemia prevalence in nonpregnant women with SF was 18.1%, and prevalence of ID (<12 µg/dL) and IDA represented 18.7% and 8.3% (46% of the anemic nonpregnant women), respectively. Among pregnant women, the prevalence of anemia was 30.5%, of ID 36.7% (<12 µg/dL), and of IDA 18.2% (50% of the anemic pregnant women).

Bolivia. In 2002, 47.4% anemia prevalence was reported among 566 children aged 6–59 months whose SF was assessed; ID prevalence (<12 µg/dL) was 32.9%. In addition, 22.3% of the children had IDA (47.0% of the anemic children). Among 538 nonpregnant women aged 15–49 years, 26.4% were anemic. Iron deficiency (SF <12 µg/dL and C-reactive protein (CRP) <8 mg/L or SF <30 µg/dL and CRP >8 mg/L) was found in 17.0% of the women. Reported IDA prevalence was 8.7%, or 33% of total anemia.

Costa Rica. In 1996, the overall prevalence of anemia was 23.7% in 266 children aged 12–83 months and 18.6% in 884 nonpregnant women aged 15–49 years. With respect to SF, 24.4% of the children had SF <12 μg/dL and 54.3% of the women of childbearing age had SF <24 μd/dL, an indicator of ID. The IDA prevalence was 12.4% in children (52.3% of the anemic children) and 10.6% in nonpregnant women (57.0% of the anemic nonpregnant women). In 64 pregnant women, 44.6% and 58.5% had SF <12 μg/dL and <24 μg/dL, respectively; IDA rates were not reported.

Dominica. A 1997 study of 157 children aged 12–59 months reported 34% prevalence of anemia. The study also reported 10.8% SF <12 μg/dL and 45.2% SF <24 μg/dL. ID was defined as SF <24 μg/dL, and 19.0% IDA was reported (56% of the anemic children). Among 150 pregnant women, 35.8% had anemia, 16% had SF <12 μg/dL, and 46.7% had SF <24 μg/dL (indicating ID). IDA amounted to 22.4% (63.0% of the anemic pregnant women).

Guyana. A 1996–97 study involving 140 children aged 6–59 months reported 45.5% prevalence of anemia, 10.6% SF <12 μg/dL, and 38.6% SF <24 μg/dL. ID was defined as SF <24 μg/dL, and 20.8% IDA was reported (46% of the anemic children). The prevalence of anemia among 269 pregnant women reached 49.3%, SF <12 μg/dL was 13%, and SF <24 μg/dL, indicating ID, was 47%. Reported IDA prevalence was 29.9% (61% of the anemic pregnant women).

Jamaica. In 1997, a total anemia rate of 46.6% in 251 children aged 6–59 months and 50.6% in 318 pregnant women was reported; 47.0% of the children and 69.2% of the pregnant women had SF <24 μg/dL, indicating ID (16.2% of the children and 26.4% of the pregnant women had SF <12 μg/dL). Overall, the reported prevalence of IDA was 30.3% in children (65% of the anemic children) and 38.7% in pregnant women (76% of the anemic pregnant women).

Nicaragua. In 2003–05, SF was measured in 869 children and 962 nonpregnant women, and ID was defined as SF <12 μg/dL in children and <15 μg/dL in women, after excluding those with Alpha-1-acid glycoprotein (AGP) >1.0 μg/L (24.2% of the children and 20.0% of the women were excluded). Reported ID rates were 37.9% in children and 30.9% in women, and the IDA rate was 6.9% in both children and women (34% of the anemic children and 62% of the anemic women).

Table 11. Summary of studies on prevalence of low serum ferritin, iron deficiency, and iron deficiency anemia in preschool children and women of childbearing age, selected LAC countries, 1996-2006

Population group	Antigua & Barbuda 1997	Argentina 2005*	Bolivia 2002	Costa Rica 1996	Dominica 1997	Guyana 1996/97	Jamaica 1997	Nicaragua 2003–05**
Preschool children								
Age (months)	12–59	6–23	6–59	12–83	12–59	6–59	6–59	6–59
Sample size	81	5,730	566	266	157	140	251	869
Anemia prevalence (%)	49.4	34.1	47.4	23.7	34.0	45.5	46.6	20.1
SF <12 ug/dL (%)	5.7		32.9	24.4	10.8	10.6	16.2	36.0
SF <24 ug/dL (%)	22.7		NR	53.7	45.2	38.6	47.0	62.0
ID prevalence (%)	22.7	34.3	32.9	53.7	45.2	38.6	47.0	37.9
% IDA prevalence (% of anemic)	13.3 (27%)	18.6 (54%)	22.3 (47%)	12.4 (52%)	19.0 (56%)	20.8 (46%)	30.3 (65%)	6.9 (34%)
Nonpregnant women								
Age (years)		10–49	15–49	15–49				15–59
Sample size		5,322	538	884				962
Anemia prevalence (%)		18.1	26.4	18.6				11.2
SF <12 ug/dL (%)		18.7						
SF <24 ug/dL (%)				54.3				
ID prevalence (%)		18.7	17.0***	54.3				30.9
IDA prevalence (%)		8.3 (46%)	8.7 (33%)	10.6 (57%)				6.9 (62%)
Pregnant women								
Sample size		1,321		64	150	269	318	
Anemia prevalence (%)		30.5			35.8	49.3	50.6	
SF <12 ug/dL (%)		36.7		44.6	16.0	13.0	26.4	
SF <24 ug/dL (%)				58.5	46.7	47.0	69.2	
ID prevalence (%)		36.7			46.7	47.0	69.2	
IDA prevalence (%)		18.2 (60%)		NR	22.4 (63%)	29.9 (61%)	38.7 (76%)	

* ID = SF <12 ug/dL in children with 6,000–15,000 leucocytes per 1,000 ml, or SF <30 ug/dL and >15,000 leucocytes per 1,000 ml.
** ID = SF <12 ug/dL and AGP <1.0 g/L in children and SF<15 ug/dL and AGP <1.0 g/L in women.
*** ID = SF <12 ug/dL and CRP <20 mg/L, or SF <30 mg/dL and CRP <20 mg/L.

The results of the studies reporting IDA prevalence (eight in children, four in nonpregnant women, and four in pregnant women) are summarized in table 11. Unfortunately, the studies covered dissimilar age groups with respect to children (6–23 months, 6–59 months, and 12–83 months). Moreover, different ID definitions (cutoffs) were used, based either on SF alone or on a combination of SF and AGP or CRP. Overall, SF <12 μg/dL was found in 12.5–36.1% of the children, and SF <24 μg/dL in 47.9–63.7% of them. Reported IDA rates were 13.3% in Antigua and Barbuda, 18.6% in Argentina, 22.3% in Bolivia, 12.4% in Costa Rica, 19.0% in Dominica, 20.8% in Guyana, 30.3% in Jamaica, and 6.9% in Nicaragua. In summary, IDA prevalence in children ranged from 6.9% in Nicaragua to 30.3% in Jamaica. The proportion of anemia attributable to ID ranged from 27% in Antigua and Barbuda to 65% in Jamaica, with an average of 47.6%, nearly one-half of the 37.6% mean prevalence of anemia in children, or an overall 18% prevalence of IDA. The use of different ID definitions, however, precludes valid comparisons between countries.

Four of the previously mentioned studies reported IDA prevalence rates in nonpregnant women: 8.3% in Argentina, 8.7% in Bolivia, 10.6% in Costa Rica, and 6.9% in Nicaragua, with an average of 8.2%. About 49.5%, or nearly half, of the anemia in nonpregnant women was attributable to ID. SF <12 μg/dL was found in 11.2–19.6% of the nonpregnant women and SF <24 μg/dL in 33.5–59.2%. Although seven studies of pregnant women reported ID prevalence, only four (Argentina, Dominica, Guyana, and Jamaica) reported IDA rates, with an average prevalence of about 50% ID, 27% IDA, and nearly 63% of anemia associated with ID. Based on the few studies reviewed, ID appears to account for a larger proportion of anemia in pregnant women (about two-thirds) than in children or nonpregnant women (nearly half). However, it must be noted once again that the lack of a standard definition of ID across studies is a major limitation.

Several studies (Argentina 1994, Costa Rica 1996, Mexico 1999, Venezuela 2002, Nicaragua 2003) assessed the levels of folate in plasma (cutoffs used were <3 ng/ml or <6 ng/ml). They also estimated the contribution of folate deficiency (FD) to anemia in children and/or women. Reported prevalence rates of FD were 6.2% (<3 ng/ml) in pregnant women in Argentina and 11.4% and 24.7% (<6 ng/ml) in children and pregnant women, respectively, in Costa Rica. Studies in Mexico reported prevalence rates of 8.8%, 8.0%, and 10.6% (<3 ng/ml) in children younger than 2 years, nonpregnant women, and pregnant women, respectively. Among pregnant women, an 11.5% FD prevalence (<3 ng/dL) was found in Venezuela (Marti-Carvajal et al., 2002). Among nonpregnant women, a 2.7% FD prevalence (<3 ng/dL) was found in Nicaragua (Nicaragua, 2004). In pregnant women from Costa Rica, FD accounted for 4.2% of anemia, and IDA and FD combined accounted for 61.2% of total anemia (Costa Rica, 1996). It must be noted that the lack of a standard definition for FD (i.e., the use of different cutoffs) is problematic.

Current policies and programs to control anemia in the region

Various policies and program interventions have been implemented in developing countries in order to reduce the incidence of anemia in the population. These include, first and foremost, a variety of programs and interventions to improve nutrition, reflecting the general consensus that anemia as a public health problem in developing countries is most often related to poor nutrition (INACG, 2003; UNICEF/UNU/WHO/MI, 1999; WHO/UNICEF/UNU, 2001; USAID/UNICEF/PAHO/WHO/FAO/MI, 2003). These interventions include pharmacological supplementation with iron and other nutrients, as well as food-based approaches such as mass mandatory, targeted, or voluntary/market-driven food fortification. Other means to improve dietary intake of key nutrients include promotion of breastfeeding; distribution of fortified complementary foods (powdered products, sprinkles, spreads, and crushable tablets) to target groups; and providing education and counseling on dietary diversification. In recent years several countries have established the policy of routinely delaying the clamping of the umbilical cord after delivery to allow more blood, and therefore more iron, to be transferred to the newborn.

In addition, various public health interventions have aimed to control nonnutritional factors associated with anemia, especially infectious and parasitic diseases such as malaria, hookworm, and schistosomiasis. These interventions include deworming by means of the periodic distribution of anthelminth medications to groups at risk, environmental sanitation, promotion of hand washing and other hygienic practices, the use of insecticide-impregnated bed nets, and the timely treatment of cases.

Iron/folate supplementation

According to The Micronutrient Report (Mason et al., 2001), by 1996–98 only 11 of the 21 LAC countries under review had a national policy on iron supplementation. Ten countries reported coverage of iron supplementation in pregnant women, with an average of 66% (range 20–100%). In these countries, the supplement supply was obtained mostly from domestic sources.

Table 12 summarizes information on current iron/FA supplementation programs from the 11 countries that responded to the PAHO/MI questionnaire. With the exception of Haiti, all of these countries have national policies, strategies, and technical norms for iron supplementation either for infants aged 6–24 months (Argentina and Peru) or for infants and preschool children aged 6–59 months, as well as for pregnant women. Most countries follow currently accepted dosage and duration recommendations (Stoltzfus and Dreyfuss, 1998), that is, 12.5 mg elemental iron daily for infants 6–24 months of age, 20–30 mg daily for children 2–5 years of age (twice per week in Colombia and Ecuador, weekly in

Guatemala), and 60 mg iron and 400 µg FA (500 µg in Colombia and El Salvador) daily for pregnant women in most countries (twice per week in Colombia and Ecuador, weekly in Guatemala). The expected duration of supplementation varies from 7 to 24 weeks for children aged 6–23 months and from 12 to 52 weeks for children aged 2–5 years. In the case of pregnant women, iron supplements are provided up to delivery (most countries) and for one to three months after delivery (Panama, Peru).

In practically all countries, the target population comprises all preschool children and pregnant women covered by local public health services (health units, centers, posts). Iron compounds used are as follows: ferrous sulfate (FS) in most countries, ferrous sulfate or ferrous fumarate (FF) in Argentina and Bolivia, and ferrus bisglycinate (FBG) or ferrous fumarate in Panama. In countries responding to the PAHO/MI questionnaire, population coverage of iron supplementation for infants aged 6–23 months ranges from 12% in Peru to 90% in Panama. For children aged 2–5 years it ranges from 17% in Guatemala to 63% in El Salvador and Nicaragua, and for pregnant women from 24% in Argentina to 96% in Panama. Mean coverage is about 40% in children and 65% in pregnant women. However, there is no standard definition of coverage across countries. Definitions vary in terms of the distribution and expected consumption of any iron supplements and with respect to compliance with technical norms regarding dosage, frequency, and duration.

Over the past several decades, many LAC countries have established iron supplementation policies and programs. These have been mostly targeted to pregnant women, infants, and preschool children, although a few countries have recently targeted schoolchildren and even nonpregnant women of childbearing age. Supplementation policies and programs in the LAC region appear to be widely influenced by 1998 guidelines from the International Nutritional Anemia Consultative Group (INACG) for the use of iron supplementation to prevent and treat iron deficiency anemia in different population groups (Stoltzfus and Dreyfuss, 1998), as well as by previous international recommendations. The INACG guidelines were endorsed by the WHO in 2001 (WHO/UNICEF/UNU, 2001). However, it is important to differentiate between technical norms and actual practices and to acknowledge that the existence of policies and norms does not guarantee that they will be fully implemented. Low coverage rates of the target population are often associated with range of factors, including problems with the procurement, distribution, and continuous supply of supplements at distribution points, a lack of motivation and commitment on the part of delivery personnel, nonexistent or poor follow-up, and low compliance.

Table 12. Iron supplementation programas targeted to preschool children and women, selected LAC countries, 2007

Programs and target groups	Argentina	Bolivia	Colombia	Ecuador	El Salvador	Guatemala	Haiti	Honduras	Nicaragua	Panama	Peru
National policies, strategies, and plans	Y/Y/Y	Y/Y/Y	N/Y/N	Y/Y/Y	Y/Y/Y	N/Y/Y	N/N/N	N/N/Y	Y/Y/Y	Y/Y/Y	Y/Y/N
Infants and children											
Age (months)	6–23	6–59	6–59	6–59	6–59	6–59		6–59	6–59	2–120	6–23 mos
National technical norms	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y
Iron compound	FS/FF	FS/FF	FS	FS	FS	FS		FS	FS	FBG/FF	FS
Iron mg and frequency	12.5 daily	12.5–25.0 daily	12.5–25.0 twice per week	25 twice per week	12.5–25.0 daily	Weekly		12.5–25.0 daily	12.5–25.0 daily	30 (<24 m), 60 (>2 yrs) daily	12.5–25.0 daily
Duration	7 weeks	12 weeks	16 weeks	12 weeks	6–23 mos: up to 23 mos 2–4 y: 8 weeks	52 weeks		6–23 mos: 24 weeks 24–59 mos: 12 weeks	16 weeks	Infants: up to 12 mos 12–59 mos: 4–8 mos	24 weeks
Coverage	20% (2005)	60% (2003)		29%, <12 mos	64% (2003)	20%, 6–23 mos; 17%, 24–59 mos		28%, 6–23 mos; 21%, 24–59 mos	63% (2003–05)	90%, 6–23 mos; 60%, 24–59 mos: 100%, 60–120 mos	12%
Pregnant women											
National technical norms	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Iron compound	FF	FS	FS	FS	FS	FS	FS	FS	FS	FF	FS
Iron/FA mg and frequency	60/400 daily	40/400 daily	60/500 twice per week	100 twice per week	60/500 daily	120 weekly	60 daily	60/400 daily	60/400 daily	60 daily	60/400 daily
Duration	40 weeks	up to delivery	up to delivery	up to delivery	up to delivery	up to delivery		24 weeks	16 weeks	up to delivery plus 3 months	up to delivery plus 1 month
Coverage	24%	28% (2002)	76% (2005)	32%	90%	80%	63%	81% (2006)	85% (2005)	96% (2006)	65% (2004)

Source: PAHO/MI questionnaire, 2007.

Y = yes; N = no; mos = months; SF = ferrous sulfate; FF = ferrous fumarate; FBG = ferrous bisglycinate; FA = folic acid

A summary of recent information on iron supplementation programs in countries of the region is provided below and in table 12. This information was either obtained directly from the pertinent public health and nutrition authorities by means of a questionnaire or was abstracted from other documents (e.g., country nutrition and/or micronutrient plans, Food and Agriculture Organization -FAO- country profiles, and study reports).

Argentina. A policy on iron/FA supplementation for pregnant and postpartum women has existed since 1988. It involves a daily dose of 60 mg iron and 400 µg FA, from the time pregnancy is confirmed up to 90 days after delivery. Supplements are distributed by antenatal and postnatal clinics. Iron supplementation is also provided to children 6–24 months of age, with a daily dose of 12.5 mg iron (either FS or FF) to be taken seven weeks per year. However, in 2005, coverage for children aged 6–23 months was only about 20% and coverage for pregnant women was 24% (Koga et al., 2008).

Belize. In 1999, an iron supplementation program targeted to children younger than 5 years was initiated.

Bolivia. Iron supplements are provided to children aged 6–59 months (12.5–25.0 mg iron daily as FS or FF) for 12 weeks a year. In 2003, coverage was 60%. Pregnant women are provided with iron (40 mg) and FA (400 µg) daily up until the time of delivery. According to a national consumption and nutrition survey in 2002 (Boy and Daroca de Oller, 2003), only 24.2% of children aged 6–59 months (17.9% urban, 29.9% rural) and 28.2% of pregnant women (19.3% urban, 37.1% rural) had consumed iron supplements.

Brazil. Women of childbearing age, either pregnant or not, and preschool children are given iron supplements only after anemia or ID is diagnosed. The dose is 40 mg iron daily as FS tablets for women and 1 mg iron/kg as FS syrup for children.

Colombia. Children aged 6–59 months are provided with iron supplements (12.5–25 mg/day as FS) for 16 weeks per year; coverage is not known. Pregnant women are given 60 mg iron (FS) and 500 µg FA twice per week up to the time of delivery. According to a 2005 survey, about 76% of women who were pregnant during the previous five years regularly consumed iron supplements (80.0% urban, 65.3% rural).

Ecuador. Iron supplements are provided to children aged 6–59 months. The dose is 25 mg (FS) twice per week, 12 weeks per year, with coverage of 29% for infants younger than 12 months. Pregnant women are provided with 100 mg iron (FS) twice a week up to the time of delivery; coverage is 32%.

El Salvador. The supplementation policy includes providing iron as FS (12.5–25.0 mg daily) to children aged 6–59 months. In 2003, coverage was 63%. Supplements are given to pregnant women (50 mg iron as FS and 500 µg FA daily) up to the time of delivery, with 90% coverage. Supplements are also provided to nonpregnant women (60 mg iron and 400 µg FA weekly) throughout the year. The 2003 survey revealed that about 63% of children aged 12–59 months had taken iron supplements, but only 7.6% had received them within the two months prior to the survey interview. The administration of iron supplements at any point in time was greater in urban areas (65.5%) than in rural areas (60.7%). The survey also found that 69.6% of children aged 24–59 months had received at least one dose of anthelminth medication; the percentage was slightly higher in urban areas (71.4%) than in rural areas (68.1%). El Salvador has developed policy and technical guidelines for the provision of iron supplementation to schoolchildren: 60 mg iron dose (FS) is given weekly at schools throughout the academic year (46 weeks), with coverage of 90%.

Guatemala. The supplementation policy targets children aged 6–59 months (weekly dose of iron as FS) for the entire year (coverage 20% in infants aged 6–24 months, 17% in children aged 2–4 years). It also targets pregnant women (120 mg iron and 400 µg FA weekly) up to the time of delivery, with an overall coverage of 80%. Guatemala is one of only three LAC countries that routinely provide supplements to nonpregnant women of childbearing age, with a weekly dose of 60 mg iron as ferrous sulfate and 400 µg FA throughout the year in all health units. Coverage is not known.

Guyana. Pregnant women attending antenatal clinics at government centers and hospitals are provided with iron supplements (60 mg as FS) and FA (400 µg) daily for at least six months. An evaluation of the iron supplementation program for pregnant women in 2001 revealed a high availability of iron supplements at the time of the survey (100% at the regional level, 94.7% at health centers). According to the evaluation, 93.5% of the women had obtained supplements from health services at least once (77% at the time of the evaluation, 68.3% in a previous pregnancy). The overall compliance rate was found to be 54% (correct dosage); noncompliance was mostly related to side effects (nausea, vomiting, and constipation). Other groups are not provided with supplements.

Haiti. Haiti appears to be the only country in the region with no policy on iron supplementation for infants and preschool children. Pregnant women attending antenatal clinics are given supplements of iron and FA (60 mg iron and 400 µg FA daily), with a coverage of about 63%.

Honduras. Children aged 6–59 months are provided with iron supplements (12.5–25.0 mg/day as FS). Infants aged 6–23 months are provided supplements for 24 weeks a year and children aged 2–4 years are provided supplements for 12 weeks. Reported coverage rates are 28% for children aged 6–23 months and 21% for children aged 24-59 months. In 1996, only 30.2% of children had taken iron supplements in the previous six months. Pregnant women are provided with daily supplements (60 mg iron as FS and 400 µg FA) for 24 weeks; in 2006, coverage was 81%.

Jamaica. In 2000, an assessment of the country’s iron supplementation program revealed that 85% of the country’s health centers had no supplements available to be distributed to pregnant women. Counseling in regard to iron supplements was given to 90% of pregnant women. Side effects (nausea, vomiting, and drowsiness) were reported by 28.7%. Only 56% of pregnant women had taken iron supplement at the time of the survey, with 70.7% of them complying with the recommended daily dosage. The assessment also indicated that 70% had taken iron supplements during their previous pregnancies and 27% had taken supplements during the postpartum period. Guidelines for pregnant women call for at least six months of 60 mg iron and 400 mg folic acid daily, but in practice, therapeutic supplementation is emphasized.

Mexico. There is a countrywide program that delivers micronutrient supplements predominantly to indigenous children younger than 5 years of age and to pregnant women.

Nicaragua. Supplementation policies target children aged 6–59 months with 12.5–25.0 mg of iron (FS) daily for 16 weeks per year (63% coverage in 2003–05) and pregnant women with 60 mg iron (FS) and 400 µg FA daily for 24 weeks (85% coverage in 2003–05). Nicaragua's management logistic system for micronutrient supplements was recently strengthened.

Panama. Since 1998, iron supplements have been provided to children aged 6 months to 10 years, as well as to pregnant women who live in priority areas with the highest anemia prevalence. Children younger than 24 months are given 30 mg iron (ACI or FF) daily for up to 12 months in their first year and for eight months in their second year. Children over 2 years of age receive 60 mg iron (ACI or FF) daily for four months per year. Pregnant women are provided 60 mg iron (FF) and 400 µg FA daily up to the time of delivery and for three months of lactation. Nonpregnant women are given 60 mg iron and 400 µg FA weekly for 16 weeks per year. A 2006 evaluation revealed that field workers were unmotivated and poorly trained. There was also a lack of information on compliance, except in regard to schoolchildren who received supplements directly from teachers. Poor quality of liquid iron supplements and poor acceptance of them by infants and preschool children were reported. Coverage rates in 2006 were 90% in infants aged 6–23 months, 60% in children aged 2–5 years, 100% in schoolchildren, and 96% in pregnant women.

Peru. Infants aged 6–23 months are provided iron supplements as FS (12.5–25.0 mg daily) for 24 weeks per year, with 12% coverage. Pregnant women are given 60 mg iron and 400 µg FA daily until delivery and for one additional month after giving birth. In 2004, coverage was 65%.

Venezuela. Iron supplements are provided to pregnant women (100 mg iron daily as ferrous sulfate and 400 µg FA) and to children 6–36 months (12.5–25.0 mg iron).

Coverage rates for iron supplementation of pregnant women recently reported from national DHS surveys (Mukuria and Kotheri, 2007) are shown in table 13. Coverage of any iron supplementation is above 60% except in Haiti, but supplementation with a duration of 90 days or more is significantly lower (above 50% only in Nicaragua and the Dominican Republic).

Table 13. Population coverage of iron supplementation for pregnant women reported by DHS in six LAC countries, between 2001 and 2006

Country, year	Any iron supplementation	90 days or more (%)
Bolivia, 2003	61.6	21.8
Colombia, 2005	75.9	-
Dominican Republic, 2002	89.1	57.1
Haiti, 2005–06	34.8	26.8
Nicaragua, 2001	78.9	61.4
Peru, 2004	64.9	20.3

Source: Mukuria and Kotheri, 2007.

Only two countries, El Salvador and Panama, have an explicit policy to provide iron supplements throughout the school year to schoolchildren or adolescents (60 mg/week as ferrous sulfate plus 400 µg FA). Coverage is reported to be 90% in El Salvador and 100% in Panama. In 2008, Guatemala started iron supplementation to schoolchildren in 43 priority localities. A number of countries have considered expanding iron/folate supplementation programs to nonpregnant women of childbearing age, but these countries have not moved forward with any initiatives along these lines. This is largely because of financial constraints, as well as challenges associated with securing effective distribution channels and developing strategies to reach the target group. Currently, only three countries (El Salvador, Guatemala, and Panama) provide supplements to nonpregnant women of childbearing age. Coverage is unknown.

Food fortification

Latin America and the Caribbean pioneered the mandatory fortification of food staples. Salt iodization began in the 1960s, and sugar has been fortified with vitamin A since the mid-1970s in Central America. Over the past several decades cereal flours (wheat and corn) have been fortified in an increasing number of countries in the region. Wheat flour has been the preferred vehicle for iron/folate fortification worldwide, with vegetable oil more recently emerging as another favored option. In the developing world, the LAC countries are leaders in wheat flour fortification. Progress in this regard has been facilitated by the high motivation and commitment of the well-developed industries in LAC countries, as well as by growing urbanization and concomitant increased consumption of processed foods. Government, industry, and public acceptance of food fortification has been high, and pertinent legislation has been developed in support of mandatory fortification (Darnton-Hill et al., 1999).

Wheat is a good source of iron, but it is mostly consumed as flour. Wheat flour is extracted from the grain through a milling process resulting in a powder product (flour) with variable rates of extraction (in percent of the total grain) ranging from unrefined high extraction flour containing most of the grain compounds (including iron, and a large amount of phytates and other inhibitors of iron absorption) to refined low extraction flour with less inhibitors but little iron. Unfortified wheat flour, no matter how refined, has some iron as well as some other nutrients. In some LAC countries wheat fortification was initially established at restoration levels, that is, about 30 mg of iron per kilogram to replace the iron lost through the milling process. However, standards were later revised to reach actual fortification levels (>44 mg/kg). A summary of the information available on the current status of iron fortification programs in LAC countries is shown in tables 14 and 15.

By 2006, practically all countries of the region had formally established mandatory programs to fortify wheat flour with iron, folic acid, and other B vitamins, particularly B1, B2, and niacin (Nutriview, 2006). Wheat flour has been considered an adequate food vehicle for iron fortification for the following reasons: centralized, regular production and marketing; widespread consumption in many countries (though less frequent and in smaller amounts in rural areas); a relatively well-developed industry; the availability of several potentially effective iron fortification compounds; and a generally positive attitude toward fortification on the part of a well-organized industry composed of multinational firms and large, medium, and small millers. The surge of wheat flour fortification in LAC countries was triggered to a large extent by formal agreements between country governments and the Latin American Association of Industrial Millers (Asociación Latinoamericana de Industriales Molineros) and the Caribbean Millers' Association. Most of the locally produced or imported wheat grain in LAC is milled in modern industrial plants, although the milling capacity of these plants currently exceeds existing demand, thus making operations rather inefficient. Currently, the largest producers of wheat flour in the region are Argentina (second in the world after the United States), Brazil, Chile, and Mexico (MI, 2007).

Information on the number of mills per country, wheat flour consumption per capita, fortification status, the iron compound used, and the mandatory level of iron fortification is quoted from a recent MI report (2007). Information was obtained from the private sector and corroborated by micronutrient mix suppliers and existing legislation in the countries. As shown in table 15, the number of mills in LAC countries ranges from one in Belize and several other countries to as many as 91 in Mexico, 102 in Chile, 108 in Argentina, and 198 in Brazil. There are a total of 730 mills in the region as a whole. The number of wheat flour mills operating in a given country may affect the complexity of law enforcement and regulatory monitoring of fortification. Per capita daily intake of wheat flour ranges from 35 grams in Paraguay to 225 grams in Chile. The weighted average for the region amounts to 96 g/day; per capita intake is above 100 g/day in nine countries and less than 100 g/day in 16 countries. Paraguay, Nicaragua, the Dominican Republic, Colombia, Ecuador, El Salvador, and Guatemala show the lowest intakes (<60 g per capita/day).

With the exception of Mexico and some countries of the Caribbean, by 2006 all LAC countries had established legislation and technical standards for the mandatory fortification of wheat flour. In 1998, a government-industry agreement was formally signed in Mexico to secure voluntary fortification of both wheat and corn flours. Mandatory levels for the iron fortification of wheat flour in the region vary from only restoration levels (<30 mg/kg) in Argentina, Chile, Mexico, and Venezuela to fortification levels (> 44 mg/kg) in the rest of the countries, with an overall average of 50 mg/kg. Ten countries in the region have used and continue to use reduced iron as a fortification compound for wheat flour; FS is used in Argentina, Chile, and Paraguay, and FF in Costa Rica, the Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua, and Venezuela. Regional guidelines regarding recommended iron compounds for food fortification were developed in 2002 (PAHO/WHO, ILSI, USAID, INACG, 2002) and have been adopted by all Central American countries as well as by some other countries in the region.

In addition to iron, most countries currently add several other nutrients to wheat flour (vitamins B1, B2, folic acid, and niacin, and in some countries vitamins A, B12, or zinc as well). Only iron and folic acid are added to wheat flour in Brazil and Uruguay, but vitamins A, B1, B2 and niacin are added in Venezuela. Mandatory levels of fortification for B vitamins vary. With respect to thiamin, levels range from 1.5 mg/kg in Venezuela to 6.3 mg/kg in Argentina; for vitamin B2 levels range from 1.2 mg/kg in Venezuela to 7.0 mg/kg in Ecuador; for folic acid levels range from 0.6 mg/kg in Ecuador to 3.3 mg/kg in Paraguay; and for niacin levels range from 13 mg/kg in Argentina and Chile to 55 mg/kg in Colombia. Zinc is added in Costa Rica and Mexico, and vitamin B12 is added in Costa Rica and the Dominican Republic. In Chile, as of 2000, FA is added to wheat flour fortified with iron and B vitamins.

There is still some confusion regarding enforcement of mandatory levels of iron fortification. This is due to unclear standards for factories and distribution points, that is, the minimum levels to be provided to the consumer, and ambiguous specifications regarding the amount of nutrient to be added to flour at the factory and the flour's total nutrient content at the market and/or the consumer level. The iron content of unfortified wheat flour in LAC may range from 10–20 mg/kg for refined low-extraction flour (70–75% extraction) to 40–50 mg/kg for unrefined high-extraction flour (>80% extraction). Most of the wheat flour consumed in the LAC region is refined, relatively low extraction flour, with an average 74% extraction and an iron content of 10–20 mg/kg. In setting and enforcing mandatory levels of iron in fortified wheat flour (in mg/kg), a distinction should be made, based on the levels of iron already existing in the unfortified flour, between the amount of iron to be added in the fortification process and the expected iron content of the final fortified product to be used for food control at the marketing and/or the household level.

The aim of fortification is to provide sufficient amounts of the deficient nutrient to the target population to meet the existing gap between the actual consumption and absorption, and the estimated average requirement of the nutrient. The expected impact of wheat flour fortification in correcting the dietary iron deficiency of the target population is contingent upon the contribution of the additional iron regularly consumed and absorbed from the fortified flour to meet the existing iron gap. As shown in Table 15, the expected additional daily per capita iron intake resulting from wheat flour fortification in LAC countries is estimated to range from as low as 1.6 mg in Paraguay, 1.7 mg in Venezuela, 2.3 mg in Colombia and Mexico, and 2.6 mg in Nicaragua, to as high as 6.8 mg in Chile and 8.3 mg in Belize. The average daily per capita iron intake for the region is around 4.2 mg/day. It would appear that in countries with relatively high wheat flour consumption (above 150 g), restoration levels of fortification may be enough to provide significant additional daily iron to the regular diet. However, in LAC countries with low wheat flour intake (i.e., in 16 countries with <100 g/day), even at common fortification levels (>44 mg/kg) the iron content of fortified wheat flour would not be enough to significantly address the iron intake gap.

In some countries, although mandatory wheat flour fortification was legislated several decades ago, legislation has not been properly enforced. The coverage and quality of fortified flour in these countries was thus uncertain. However, in the second half of the past decade (90's), not only have many additional countries adopted legislation requiring that wheat flour be fortified with iron and some vitamins, but most countries have also revised and updated their legislation and technical specifications. At the same time, more effective regulatory monitoring systems have been established in a number of countries. In some Central American countries, the quality and coverage of mandatory fortification programs are being periodically evaluated, at the consumer level, by means of household monitoring of fortified foods. However, in several other countries, quality control at production plants is weak or nonexistent and government regulatory monitoring at plants and retail outlets is insufficient. These factors have been identified as major constraints to program effectiveness and sustainability.

Table 14. Main characteristics of wheat flour fortification with iron, selected LAC countries, 2006

Country	No. of mills in country	Per capita intake of wheat flour (g/day)	Mandatory iron level (mg/kg)	Additional iron supply (mg/day)	Type of iron used	Population coverage % (year)	Other nutrients added (mg/kg)
Argentina	108	198	30	5.9	FS		B1 (6.3), B2 (1.3), FA (2.2), niacin (13.0)
Belize	1	138	60	8.3	RI		B1 (4.0), B2 (2.5), FA (1.5), niacin (45.0)
Bolivia	19	89	60	5.3	FF		B1 (4.4), B2 (2.6), FA (1.5), niacin (35.6), B12 (15)
Brazil	198	88	42	3.7	RI		FA (1.5)
Caribbean*	12	129	44	5.7	RI		B1 (4.4), B2 (2.7), FA (1.5), niacin (35.0)
Chile	102	225	30	6.8	FS		B1 (6.3), B2 (1.3), FA (2.2), niacin (13.0)
Colombia	48	52	44	2.3	FF/RI	100 (2007)	B1 (6.0), B2 (4.0), FA (1.5), niacin (55.0)
Costa Rica	2	83	60	5.0	FF/RI		B1 (6.0), B2 (4.0), FA (1.5), niacin (55.0), zinc
Cuba	5	106	45	4.8	FF/RI		B1, B2, FA (2.5), niacin (70.0)
Dominican R	5	50	60	3.0	FF	60	B1 (5.4), B2 (3.6), B12, FA (1.8), niacin (45.0)
Ecuador	23	58	55	3.2	RI	70 (2006)	B1 (4.0), B2 (7.0), FA (0.6), niacin (40.0)
El Salvador	2	57	55	3.2	RI/FF	99 (2006)	B1 (4.0), B2 (2.5), FA (1.8), niacin (45.0)
Guatemala	18	57	55	3.1	RI/FF	91 (2006)	B1 (5.4), B2 (3.6), FA (1.8), niacin (45.0)
Guyana	1	ND	45	ND	FS	100 (2003)	B1 (6.3), B2 (3.9), FA (1.5), niacin (52.8)
Honduras	5	58	55	3.2	RI/FF	91 (2003)	B1 (5.4), B2 (3.6), FA (1.8), niacin (45.0)
Jamaica (V)	1	140	44	6.2	RI		B1 (6.3), B2 (3.9), FA (1.5), niacin (52.8)
Mexico (V)**	91	67	35	2.3	RI	100	B1 (4.0), B2 (2.4), FA (2.0), niacin (28.8), zinc (16.0)
Nicaragua	3	47	55	2.6	RI/FF	77 (2007)	B1 (5.4), B2 (3.6), FA (1.8), niacin (45.0)
Panama	4	73	60	4.4	RI	100 (2007)	B1 (5.4), B2 (3.6), FA (1.5), niacin (45.0)
Paraguay	44	35	45	1.6	FS	100	B1 (4.5), B2 (2.5), FA (3.0), niacin (35)
Peru	14	92	55	5.1	RI	100 (2007)	B1 (5.0), B2 (4.0), Niacin (48.0), FA (1.2)

Table 14. Continued

Country	No. of mills in country	Per capita intake of wheat flour (g/day)	Mandatory iron level (mg/kg)	Additional iron supply (mg/day)	Type of iron used	Population coverage % (year)	Other nutrients added (mg/kg)
Suriname	1	99	44	4.4	RI	100	B1, B2, niacin
Uruguay	15	182	30	5.5	FS/FF	100	FA (2.4)
Venezuela	8	83	20	1.7	FF	100	A, B1 (1.5), B2 (2.0), niacin (20.0)
Total	**730**	**96*** **	**50*** **	**4.2*** **			

Sources: PAHO/MI questionnaire, 2007; MI, 2007; Nutriview Special Issue, 2003.
* Mandatory (CAPRICOM): Barbados, Curacao, Grenada, Guadalupe, Guyana, Haiti, St. Vincent & Grenadines, and Trinidad & Tobago.
** Government-industry agreement.
*** Unadjusted mean.
V = voluntary; FA = folic acid; ND = not defined; FF = ferrrous fumarate; RI = reduced iron; FS = ferrrous sulfate.

Data on population coverage of wheat flour fortification are available from 15 of 28 countries (table 14). Reported coverage ranges from 60% in the Dominican Republic to 99–100% in Colombia, El Salvador, Mexico (voluntary fortification), Panama, Paraguay, Peru, Suriname, Uruguay, and Venezuela. However, no standard definition of coverage is used across countries. There must be a routine or ongoing system for monitoring and keeping track of program implementation performance before the effectiveness of the fortification policy can be assessed. Nine countries appear to lack a routine system for monitoring fortified foods that could be used to assess the implementation of the fortification policies. A food control and regulatory monitoring system and, eventually, a system for household monitoring of fortified foods are necessary. However, another series of actions are also needed to achieve and maintain higher levels of quality and coverage with respect to food fortification and to determine whether effective implementation actually leads to biological improvement.

Fortification of other staple foods (corn flour, pastas, rice flour, liquid milk, and powder milk) with iron and eventually other nutrients is either mandatory or voluntary in 14 countries in the region (table 15). Corn flour is fortified with iron and B vitamins at mandatory levels of iron in four countries (22–42 mg/kg in Brazil, Costa Rica, and El Salvador; 24-40 in Mexico and 50 mg/kg in Venezuela) and at voluntary levels of about 22 mg/kg in four countries (Guatemala, Honduras, Nicaragua, and Panama). Precooked corn flour has been fortified with iron in Venezuela since 1991, and there is an effective monitoring system in place. The iron fortification of corn flour at a level of 24–40 mg/kg is voluntary in Mexico under a government-industry agreement. In Costa Rica, rice is fortified with iron at a mandated level of 19 mg/kg and with vitamins B1, B2, E, FA, and niacin, selenium, and zinc. Rice fortification with iron (15 mg/kg) and vitamins B1, B2, and niacin is also mandatory in Venezuela and is done on a voluntary basis in Argentina.

Table 15. Iron fortification of foods other than wheat flour, selected LAC countries, 2006

Country	Voluntary	Mandatory	Level (mg/kg)	Type of iron	Other nutrients added
Argentina	Liquid milk	Targeted PM*	20	FS	C, zinc
	PM				
	Rice				
Brazil		Corn flour	42	RI	FA (1.5)
Bolivia	Liquid milk				
Colombia	Liquid milk				
	PM				
	Pastas				
	Rice				
Costa Rica		Corn flour	22	FGB	B1 (4.0), B2 (2.5), FA (1.3), niacin (45.0)
		Rice	22	FF	B1 (5.3), B2 (3.5), E (15), FA (1.8), niacin (35.0)
Ecuador	Liquid milk				
	PM				
El Salvador	Liquid milk	Corn flour	22	FF	B1 (4.0), B2 (2.5), FA (1.3), niacin (45)
	PM				
Guatemala	Corn flour		22	EI	B1 (4.0), B2 (3.7), niacin (59.5)
	Pastas		26.8–36.8		B1 (9.9), B2 (4.3), niacin (67.0)
	Liquid milk				
	PM				
Honduras	Corn flour		22	EI	B1 (4.0), B2 (2.5), FA (1.3), niacin (45)
	Liquid milk				
	PM				
Mexico**	Corn flour		24–40	EI	B1 (4.0), B2 (2.4), FA (0.4), niacin (28), zinc (24)
Nicaragua	Corn flour		22	EI	B1 (4.0), B2 (2.5), FA (1.3), niacin (45)
	Liquid milk				
	PM				
Panama	Corn flour		22	EI	B1 (4.0), B2 (2.5), FA (1.3), niacin (45)
	Liquid milk				
Peru	Liquid milk	Pastas			
	PM				
Venezuela		PC corn flour	50	FF/RI	A (9,000 IU), B1 (3.1), B2 (2.5), niacin (51)
		Rice flour	15	FF/RI	B1 (1.0), B2 (1.2), niacin (10)

Source: PAHO/MI questionnaire, 2007.
* Powder milk for supplementary feeding programs.
** Government-industry agreement.
PM = powder milk; PC = precooked; FS = ferrous sulfate; FF = ferrous fumarate; EI = eletrolytic iron; FBG = ferrous bisglycinate; RI = reduced iron.

Fortification of liquid and/or powder milk is voluntary in most of the 14 countries, except in Argentina, where mandatory fortified powder milk is distributed through social programs. In Chile, milk fortification began in 1998, and fortified powder milk (iron 5 g, copper 0.5 mg, and vitamin C 70 mg per 100g) has been distributed to children 6–23 months and pregnant women since 1998. An evaluation in 130 children aged 12–18 months showed a reduction in the prevalence of anemia from 27.3% to 8.8% (Hertrampf et al., 2001). Fortification of pastas is mandatory in Peru and voluntary in Guatemala; in a number of countries pastas are made from fortified wheat flour.

Other intervention programs

At least five other programs are being implemented in LAC countries specifically to improve iron and other micronutrient status in children or women.

Periodic deworming is done by distributing anthelminth medications to children aged 2–5 years once or twice per year through primary health care services in El Salvador, Guatemala, Honduras, and Nicaragua; to preschoolers and schoolchildren attending primary schools in Argentina, Haiti, and Panama; and to schoolchildren in Peru.

Vitamin-mineral sprinkles (“Chispitas”) are delivered to children aged 6–24 months in Bolivia and to children 6–59 months in one province in Guatemala through primary health care services. Pilot programs are being implemented in many other countries in the Region and plans for national distribution are in the planning stage period.

Especially designed fortified complementary foods are distributed free to low-income children aged 6–24 months and/or to pregnant women in Bolivia (Nutribebe), Chile (Leche Purita Fortificada for infants), Colombia (Bienestarina, targeted to low-income children), Cuba, Ecuador (Mi Papilla and Mi Bebida in priority areas), Guatemala (Vitacereal in 83 localities), Mexico (Nutrisano), Panama (Vitacereal), and Peru (PIN, PRONAA). Overall, these complementary foods provide about 5–10 mg iron daily. Mexico has a long history of creating policies and programs to improve the nutrition of vulnerable groups, particularly food assistance programs. Countrywide programs targeted to low-income families include the Programa Oportunidades, which provides conditional cash transfers to about 5 million low-income families, and the Liconsa Social Milk Supply Program (Programa de Abasto Social de Leche Liconsa), which delivers fortified milk to about 4.6 million children aged 1–12 years.

BOX 3

Key Reasons for Lack of Progress in Reducing Anemia

√ Low awareness of the problem and weak political commitment to solving it
√ Weak management, operational, and support systems
√ Inconsistent efforts to promote behavioral change
√ Excessive reliance on iron-focused interventions, especially fortification of a single food
√ Poor congruence between established goals and reasonable impact expectations
√ Lack of integrated program interventions
√ Sporadic or nonexistent program monitoring and evaluation

A specific policy to delay clamping the newborn umbilical cord after delivery is implemented only in Argentina, Colombia, and El Salvador. However, there are no data on how often the policy is put into practice. A similar policy is being developed in Nicaragua and Ecuador, where a successful breastfeeding promotion and protection program has been implemented for a long time.

Some countries (e.g., El Salvador, Nicaragua) carry out systematic nutrition education and counseling on anemia and iron supplementation. Micronutrient education is also included in the primary school curriculum.

Anemia and iron deficiency: A continuing public health problem

In the twenty-first century, anemia remains a widespread public health problem and a serious challenge to social and economic development in most countries of the LAC region. This is the case despite international declarations, high-level advocacy, national anemia reduction goals, and the implementation of anemia control interventions in many countries over the past few decades. There is not enough information available to estimate national prevalence rates, the population affected, and trends in all countries of the region. Nonetheless, there is information available from a large number of countries. This information confirms that certain groups are at greatest risk of anemia: infants; young preschool children, particularly those under 36 months of age; and women of childbearing age, especially during pregnancy.

In LAC countries, anemia affects about two-thirds of infants aged 6–11 months, almost half of children aged 6–59 months (close to one-third of those 12–59 months), a quarter of nonpregnant women of childbearing age, and about one-third of pregnant women. In several countries, anemia in preschool children and/or women of childbearing age is a moderate public health problem. Fortunately, severe anemia is infrequent (<2% in pregnant women, <1% in other groups). The extent of anemia in the following groups has not been systematically assessed: children under 6 months of age (this group is thought to be at lower risk), school-aged children, adolescents, adult males, and the elderly (the latter group is known to be at moderate to high risk). If an extrapolation is made from the countries for which information is available to the entire region, it is estimated that in 2005 the total anemic population of children aged 6–59 months, nonpregnant women of childbearing age, and pregnant women in the region amounts to about 57.7 million people. This breaks down to 22.5 million children aged 6–59 months, 31.7 million non pregnant women, and 3.5 million pregnant women. In addition, there are undetermined numbers school-aged children, adolescents, adult men, and women 50 years of age or older with anemia.

Although different estimation methods were used to prepare the present report, total regional estimates of the anemic population in 2005 do not differ greatly from those found in earlier comprehensive reports. Subregional estimates for 2000 (Mason et al., 2005) were made for Central America and the Caribbean (4.4 million for preschool children, 11.3 million nonpregnant women, and 1.5 million pregnant women) and for South America (14.8 million preschool children, 19.7 million nonpregnant women, and 3.2 million pregnant women). The regional total was estimated to include 19.2 million preschool children, 31 million nonpregnant women, and 4.7 million pregnant women. Most recent estimates for the entire LAC region (McLean et al., 2007) provide 95% confidence intervals (CI) and are somewhat higher: 22.3 million (CI: 20.3–24.3 million) preschool children0–5 years; 33.0 million (CI: 22.4–43.6 million) nonpregnant women; and 3.6 million (CI: 2.5–4.7 million) pregnant women.

The estimated trends found in our study reinforce the conclusion of Mason et al. (2001, 2005) that we are making little progress, if any, in reducing the prevalence of anemia in LAC countries over the past two decades. In fact, the absolute magnitude of the anemic population may have increased with overall population growth. By and large, repeated surveys using comparable sampling frames and/or methods of hemoglobin assessment with average intervals of 10–12 years show no overall change in the prevalence of anemia in preschool children aged 12–59 months, some increase (about 3.9% of the baseline rate) in nonpregnant women, and a significant drop in pregnant women (from 43.2% to 28.1%, or about one-third of their baseline rate). Some countries have shown significant reductions in anemia rates among specific groups (>20% of the baseline), notably in children aged 12–59 months (Dominica, Dominican Republic, Jamaica, Mexico, Nicaragua, Peru), in nonpregnant women (El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Peru), and in pregnant women (El Salvador, Guatemala, Guyana, Haiti, Honduras, Mexico, Panama, and Peru). However, other countries show significant increase (>20% of the baseline) in children 12-59 months (Colombia, Ecuador, Guatemala, Panama), in nonpregnant women (Bolivia, Colombia, Panama), and in pregnant women (Bolivia, Cuba, Dominica, Ecuador).

The relatively small number of countries for which trend analyses could be undertaken may have affected the validity of the overall trends reported. Nonetheless, the lack of improvement in anemia rates among preschool children is disappointing, as is the mild increase in prevalence rates among nonpregnant women. Iron supplementation programs, which are targeted to pregnant women as well as to infants and young children, seem to have been ineffective in reducing anemia in children. Nonpregnant women of childbearing age would have been expected to benefit from increased iron intake resulting from wheat flour fortification more than young children; however, as discussed earlier, the consumption of fortified wheat flour by women may not be sufficient to meet the intake gap in countries with relatively low consumption (<100 g per person/day). The significant reduction in the prevalence of anemia in pregnant women is likely attributable to iron/folate supplementation during pregnancy with relatively high coverage (about 65% in 11 countries), duration, and compliance, as well as an undetermined, but perhaps modest, additional input from fortified wheat flour in some countries. The magnitude of the trends in the prevalence of anemia estimated in this report is notably congruent with previous estimates for the period 1990–2000 (Mason et al., 2005), except with respect to the significant decline in anemia among pregnant women.

In summary, our review finds that little progress has been made in reducing anemia rates in the LAC region, with the exception of significant reductions among pregnant women in a few countries. There have been worsening trends in several countries with respect to preschool children, nonpregnant women and even pregnant women. In a number of other countries, the trends are unclear or the situation has remained unchanged. A reduction by one-third of the current regional rate of anemia among pregnant women may be a reasonable goal for the year 2015. This goal may be achievable given the current rate of progress in overall anemia reduction among pregnant women. However, given the lack of progress in reducing anemia in children and nonpregnant women, it is clear that significant reductions in anemia rates in these population groups cannot be expected, unless programs that are more effective are put in place. In order to reduce anemia rates, substantial improvements would have to be made in building awareness and strengthening political and financial commitments to control anemia, as well as in the development, implementation, monitoring, and evaluation of the biological effectiveness of national prevention and control policies and programs.

The following factors help explain why there has been little progress in reducing anemia in the LAC region over the past two decades, despite the fact that most countries have policies in place to address anemia and have made relatively large investments in anemia control intervention programs.

Insufficient political commitment

There appears to be a general lack of awareness of the magnitude of anemia prevalence in the LAC region. Moreover, the functional consequences of anemia for individuals, the health and economic implications for the population, and the impact of anemia on a country's social and economic development are also not well understood. This lack of knowledge appears to have resulted in weak political commitment and low individual awareness of anemia as a priority issue. The need to prevent and control anemia may not be attracting attention because the health and survival implications of anemia for the individual often are not readily visible and the consequences of anemia for national economic growth and social development are difficult to quantify. Compared to more visible and highly publicized health and nutrition problems, anemia continues to receive relatively low priority in national public health policies.

Existing anemia control intervention programs in many countries have been established and implemented primarily as a result of international commitments rather than as a consequence of a full awareness of the problem, solid political commitment by central governments and public health authorities, and strong community demand. Therefore, the implementation of anemia control intervention programs has suffered from a lack of sustained political commitment, insufficient human and financial resources, an absence of systematic supervision and monitoring, limited consideration of implementation management and operational issues, and insufficient community involvement. Additional constraints include a scarcity of solid information from formal program evaluations about best practices for reducing anemia and the disappointing results of most large-scale intervention efforts (Yip, 1996; Gillespie, 1998; UNICEF/UNU/WHO/MI, 1999; Allen and Gillespie, 2001).

Weak management, operational, and support systems

In many countries, inefficient implementation of anemia control program interventions (e.g., iron/folate supplementation) have led to unsystematic delivery and less than satisfactory coverage of the target population. Supply, demand, and compliance problems have frequently plagued iron/folate supplementation programs in developing countries (Galloway and McGuire, 1994; Yip, 1996; MotherCare, 1997; Gillespie, 1998). These problems are likely to also affect other programs that are expected to deliver services on a continuous basis (e.g. reproductive health and malaria control programs). Iron/folate supplementation programs are particularly problematic since they require a continuous supply of supplements and the systematic routine distribution of them through health services and other delivery networks. In fact, a major constraint of iron/folate supplementation, deworming, and other programs that deliver services on a continuous basis to the target population is the lack of effective management logistics systems. These systems are necessary in order to ensure an uninterrupted supply of supplements, anthelminth, and other medications at local health services and other distribution points.

Mean coverage of iron supplementation in 11 LAC countries barely reaches 40% in children and 65% in pregnant women.

The importance of the following in iron supplementation cannot be emphasized enough: effective logistics management systems; proper delivery systems eventually utilizing unconventional distribution networks (e.g., nongovernmental organizations, community health volunteers); clear messages regarding dosage, frequency, and duration; and adequate supervision and training on counseling, prevention, and the management of adverse effects. In 2004, the Ministry of Health in El Salvador developed and established a prototype management logistics system for micronutrient supplements (Lins et al., 2004) that has been adapted by other Central American countries (Guatemala, Honduras, Nicaragua).

In many countries, iron supplement coverage and compliance rates are unknown. A MotherCare review of the situation in eight developing countries found that although one-third of pregnant women reported negative side effects, only about one-tenth of the women stopped taking the tablets because of side effects. The review found that the major barrier to effective supplementation programs was inadequate supply (MotherCare, 1997). Additional barriers included inadequate counseling and distribution of tablets, difficult access to and poor utilization of antenatal health care services, and some women's reluctance to consume medications during pregnancy. No reports in the literature were found that specifically address the way persistent side effects affect compliance in children.

Nonsystematic communication efforts to promote behavioral change

Inadequate feeding and health care practices represent important, immediate determinants of the risk for nutritional anemia in the population. Examples include diets with predominance of poorly absorbed non-hem iron vegetable sources and little consumption of heme animal sources, low utilization of health care services and incomplete compliance with counseling regarding nutrition and supplements. It is thus generally accepted that a behavioral change communication (BCC) intervention should be part of an integrated approach to anemia control. The intervention should improve feeding practices through nutrition education and support specific anemia control interventions, particularly those delivered through primary health care services (Hyde et al., 2003). BCC is commonly combined with intensive training for health care delivery personnel.

The objectives of the dual BCC/training strategy are as follows: to sensitize communities and promote community participation in priority efforts to control micronutrient deficiencies; to increase intake of micronutrient-rich foods (fortified foods or natural foods based on dietary diversification) by means of person-to-person education and social communication; and to improve the quality of health care services targeting micronutrient deficiencies (e.g., iron/folate supplementation, deworming) and increase the use of these services. There have been some disappointing results from efforts to improve iron intake in populations at risk of ID by promoting dietary diversification (Allen & Gillespie, 2001). However, well-designed and well-implemented BCC interventions have been shown to effectively complement and enhance the impact of other program interventions, in addition to improve dietary intake and absorption of iron (Hyde et al., 2003). Unfortunately, with a few exceptions (Bolivia, Nicaragua, Peru), BCC has been generally been designated a low priority in current efforts to address anemia in LAC countries.

Excessive reliance on iron-focused interventions

Anemia control interventions have been largely limited to actions aimed at improving iron intake and nutritional status because of the assumption that most anemia is attributable to ID. Consequently, the contribution of other important etiologic factors is ignored, thereby limiting the potential effectiveness of efforts to reduce the prevalence of anemia (Stoltzfus, 2001a, 2001b). ID is not the only cause of anemia; the disorder cannot, therefore, be fully addressed simply by increasing iron intake. ID, with or without anemia, has important implications for human health and child development. However, the disappointing results of many efforts to reduce anemia in developing countries may to some extent be explained by the fact that program interventions seem to follow the untenable assumption that all, or most, anemia is attributable to ID. This is the case despite the fact that relatively few studies have examined the relative contribution of ID to anemia in children and women worldwide or in the LAC region. Indeed, the most effective ID interventions would likely reduce most IDA but would only reduce a limited proportion of total anemia.

In addition to ID, other causes of anemia include other nutritional deficiencies (e.g., vitamins A, B2, B6, B12, and folate), as well as parasitic infections, particularly hookworm, malaria, and schistosomiasis in endemic areas, and systemic infections (Yip & Dallman, 1988; Van den Broek and Letsky, 2000). A relatively high proportion of the anemia seen in developing countries appears to be related to ID; however, the contribution of other nutritional deficiencies and of intestinal parasites and common infections has not been properly quantified, although it is presumed to be relatively high (Gillespie & Johnson 1998, UNICEF/UNU/WHO/MI 1999). The contribution of ID to anemia can only be estimated by assessing the prevalence of both total anemia and IDA in the same population group. Unfortunately, however, the prevalence of anemia and ID is likely to vary in different populations, and there is no consistent relationship between the two conditions. Well-designed, large-scale studies on the etiology of anemia have not been conducted in many LAC countries. The lack of information on the magnitude of IDA in developing-country populations may be because there is no international agreement on iron deficiency indicators, and laboratory assays to quantify the contribution of ID and other nutrient deficiencies to the total prevalence of anemia are relatively complex and costly (WHO/CDC, 2005).

Reliance on mass fortification of a single food

From the public health point of view, food fortification has been defined as the addition of one or more micronutrients (that are deficient in the diet of the population) to an edible product that is manufactured regularly by the food industry. Attractive features of food fortification are the relatively low cost of adding micronutrients to a suitable food vehicle and the ease with which the fortified food is transferred to the consumer. Fortification is therefore a cost-effective way for a government to improve micronutrient intake. In the LAC region, iron fortification initiatives have long centered on mass wheat flour fortification. Some characteristics of wheat flour production and consumption may enhance or limit the potential of fortification to increase iron intake enough to improve iron nutritional status. To be considered a suitable vehicle for affordable mass fortification, a food staple should be produced by centralized industries with adequate systems of production and trade. Wheat flour manufacturers in LAC countries generally meet these conditions; however, per capita consumption of wheat flour widely varies by country and also by urban/rural area and socioeconomic strata within countries. In some countries corn and maize flour are more regularly consumed than wheat flour, and low income rural households are less likely to regularly consume bread and other wheat flour products.

In addition to regular consumption of sufficient amounts of the food vehicle, effectiveness of a mass fortification program is contingent upon the technical feasibility of adding significant amounts of the nutrient to the unfortified food and the levels of absorption of the nutrient added. These are, in turn, dependent on the food matrix, that is, the physical and chemical characteristics of the food vehicle. Interaction with specific compounds in the food matrix may impose limits to the amount of iron that can be added to wheat flour without producing undesired organoleptic changes in the product that may render it less suitable for baking and/or less attractive to the consumer thus affecting its marketability and consumption. The presence and level of iron absorption inhibitors (phytates and others) may limit iron absorption from fortified wheat flour. Likewise, the bioavailability of the iron compound for absorption (in terms of percentage of absorbable iron), may affect the expected effectiveness of a wheat flour fortification program in meeting the iron gap of the population, and many LAC countries continue using iron fortificant compounds with questionable bioavailability.

In a recent comprehensive analysis of the practical limitations of food fortification for controlling nutritional anemia, Dary (2007) describes characteristics of the food matrix that are critical for the effectiveness of mass fortification programs. With respect to the iron fortification of flours, the key factor limiting iron content is technological, that is, the incompatibility between the iron compounds and the food matrix. In fact, iron must be added in relatively low amounts to prevent undesirable changes in the sensorial properties of flours. The maximum feasible amount varies with the iron compound used (e.g., around 25 mg/kg from FS and 50 mg/kg from FF in low-extraction, highly refined wheat flours, and much lower levels in high-extraction unrefined flours). The magnitude of the biological impact of a fortified food will be related to the proportion of the estimated average requirement (EAR) or the recommended nutrient intake (RNI) supplied and absorbed. In countries with significant ID, it would require an additional iron intake of at least 60% EAR to improve iron stores and at least 90% EAR to decrease nutritional anemia.

Dary concludes that, given the customary amounts of iron added to wheat flour and average wheat flour consumption of 100 g/day the additional iron supply provided by the refined flours available in most LAC countries may meet only 18–32% of women's estimated EAR or 8–15% of the RNI. In the case of unrefined flours, 7–14% EAR or 3–7% RNI may be met. These observations raise doubts about whether wheat flour fortification is an effective way to improve iron intake in LAC countries with a per capita flour intake below 100 g/day. A significant biological impact would be even more questionable when iron compounds with lower or uncertain bioavailability, such as reduced iron, are used (PAHO, 2002; Hurrell & Egli, 2007). However, wheat flour may still be an effective vehicle for other nutrients (e.g., vitamins A and B, zinc). In summary, in countries with a per capita intake below 100 g/day, iron fortification of wheat flour alone is not likely to significantly improve iron nutrition. This is even more true when the diet includes iron absorption inhibitors, as is the case in most LAC countries.

Poor congruence between established goals and reasonable impact expectations

Program goals regarding the magnitude of the expected reduction in anemia rates after a reasonable implementation period should be established in congruence with specific program activities, minimum useful population coverage levels, and the expected achievements in intermediate results (i.e., additional intake and absorption). A minimum population coverage, duration, and compliance with the consumption of micronutrient supplements and/or fortified foods would be required to ensure fulfillment of program goals to improve nutritional status with respect to specific nutrients. The magnitude of the biological impact of a program to reduce anemia in the population through improvements in nutrient intake will be contingent upon the extent to which the intervention covers the existing intake gap of specific micronutrients contributing to anemia. On the other hand, interventions aimed at improving iron intake and utilization would not be expected to reduce total anemia beyond the proportion attributable to IDA. Most anemia control programs are restricted to addressing ID, principally through iron supplementation and fortification. Therefore, program impact goals should be adjusted to be congruent with the expected impact of these interventions. Unfortunately, taking this approach would require a reliable estimate of IDA and its contribution to total anemia; this information is often either not available or not taken into account in establishing anemia reduction goals.

Lack of integration of program interventions

There is a lack of diverse, integrated program interventions that address anemia as a complex problem with multiple causes beyond ID. The fact that integrated program interventions are not considered may represent a major constraint, particularly when factors other than ID contribute significantly to anemia in the population (INACG, 2003). Lessons learned indicate that an effective anemia control strategy should be evidence-based, tailored to local conditions, and grounded in the specific etiology and prevalence of anemia in a given setting and population group (WHO/UNICEF, 2004; MOST/USAID, 2004). Reports from successful anemia control programs (Harvey, 2004; MOST/USAID, 2004; Deitchler et al., 2004; Mora, 2007a) reveal that the most salient feature of effective country programs has been the use of a multipronged, comprehensive approach that addresses the major preventable causes of anemia in the context of expanded coverage and good-quality antenatal and childcare services, with the active participation of community health volunteers.

Successful countries have combined several approaches, including providing iron and iron/folic acid supplements to young children and pregnant women, undertaking deworming and malaria control, and carrying out effective mass food fortification. Some have also addressed known barriers to the implementation of supplementation programs through comprehensive training of both health service personnel and volunteers; BCC to improve awareness, knowledge, attitudes, and practices of target groups; and special efforts to remove existing supply and demand constraints affecting supplementation coverage and compliance (Harvey, 2004). This has been the case in Nicaragua, where the prevalence of anemia declined in 12 years (1993–2005) from 28.5% to 18.1% in preschool children (Mora, 2007a).

The very high prevalence of anemia in infants aged 6–11 months in the region indicates that infants are becoming anemic early in life when iron reserves should still be adequate to meet iron needs. Along with enhanced coverage and quality of health care services during pregnancy and delivery, the simple practice of delaying clamping of the umbilical cord, if systematically implemented on a routine basis, will likely contribute to anemia prevention in the first half of infancy (Grajeda et al., 1997; Hutton and Hassan, 2007). Delayed clamping facilitates the additional transfer of placental blood, and thus of iron, in order to enhance the newborn's stores of iron and help prevent anemia in infancy. PAHO/WHO has recently developed a technical document providing specific guidance regarding integrated practices in labor and delivery care aimed at improving the health and nutrition of mothers and children, with a particular emphasis on not clamping the umbilical cord until pulsations cease (about 2-3 minutes) (Chaparro and Lutter, 2007).

Improvement in breastfeeding practices is also an important component of anemia control in infancy. Although the iron content of breast milk is relatively low, it is highly bioavailable, particularly for infants with lower iron levels. Introducing other liquids or solids in the first six months of life can have negative effects on infant iron status. With the exception of iron-fortified formula, these foods are generally low in iron and can interfere with the absorption of breastmilk iron. Early use of cow's milk can also contribute to iron loss by causing blood loss in the intestine.

Sporadic or nonexistent program monitoring and evaluation

Few countries in the LAC region have established functional monitoring and evaluation (M&E) systems for anemia control programs. It has been suggested that implementing micronutrient programs without adequate evaluation is equivalent to, for example, running immunization campaigns without monitoring coverage, vaccine efficacy, or the integrity of the cold chain (Mason et al., 2005). Some efforts have been made to establish M&E systems for micronutrient programs, particularly for iron/folate supplementation and food fortification programs in Central American and some South American countries. However, much work still needs to be done to ensure that effective M&E systems support program implementation, decision making, and program evaluations. In many countries, the only information on coverage of iron/folate supplementation is collected at several-year intervals by DHS or FHS surveys. The regulatory monitoring of fortified foods is still weak, and household monitoring is totally absent. Nicaragua, however, has made significant process in the M&E of micronutrient and other nutrition programs through the Integrated Nutrition Surveillance System (SIVIN), which has been in full operation since 2002 (Mora, 2007b).

An effective program M&E system periodically assesses the quality of project inputs and services, the timeliness of service delivery, the degree to which the targeted individuals and communities are reached, the acceptability and use of the services, the costs involved in implementing the program, and the extent to which actual implementation corresponds to the program's implementation plan. Information generated from a process M&E system provides valuable clues as to whether and where problems are occurring, why program operations are succeeding or failing, and which specific aspects of the program need to be adjusted to improve targeting, coverage, and/or the use of services (McKenzie et al., 2005). Data are routinely collected, analyzed, and reported in ways that can be used for timely and informed decision making. When information is collected and analyzed at regular intervals, problems can be addressed as they arise and corrective measures can be instituted, thus improving the chances of program success.

Meeting the challenge of reducing anemia and iron deficiency

As we have seen, anemia continues to be a significant public health problem and a formidable challenge in the LAC region. Little progress has been made in addressing anemia in recent decades, except with respect to pregnant women. As detailed in the preceding section, a number of reasons may account for the persistence of the problem, including weak political commitment to anemia control, lack of effective program interventions that recognize the multiple etiology of anemia, poor implementation of existing large-scale programs of supplementation and food fortification, and inadequate monitoring and evaluation of the interventions used.

What can be done? A series of concerted actions to address these constraints are urgently needed in the region.

BOX 4

Recommended Measures to Improve Anemia Control

- √ Raise awareness of the problem and strengthen advocacy for policy and program development
- √ Develop interventions to address anemia based on analysis of its multiple causes
- √ Document and improve the effectiveness of program interventions
- √ Develop multiple integrated control strategies and integrate them into primary care
- √ Improve the design and implementation of iron supplementation and food fortification programs, as well as nutrition education through behavioral change communication (BCC).
- √ Expand applied and operational research
- √ Strengthen the capacity of the public sector to carry out program interventions and enlist the support of the private sector, community groups, and nongovernmental organizations

First of all, there is a need to bring the serious problem of anemia to the forefront of social and economic development efforts by generating greater awareness at all levels of society regarding the health, functional, and economic implications of anemia. Stronger advocacy is needed to drive more effective policy and program development for anemia control, as well as more effective implementation.

Simple and affordable approaches and methods, including biochemical assays, should be developed to estimate the relative contribution of the main factors responsible for anemia—including, but not limited to, iron and other nutrient deficiencies—at a country and population level. This information can be used to develop the best possible mix of program interventions to address these factors and set realistic goals for the proposed interventions. In addition, there is a need to develop ID indicators and cutoffs with more robust, less invasive, and affordable biochemical methods.

More efforts are needed to document the actual effectiveness of program interventions in different countries so that proven, effective technologies and best practices for the prevention and control of anemia become readily available. Of particular importance are efforts to improve the effectiveness of supplementation, by addressing supply and demand constraints, and of food fortification, by including potentially effective food vehicles other than or in addition to wheat flour. Steps should be taken to establish or strengthen program monitoring and evaluation systems, secure adequate bioavailability of fortification compounds, and develop educational interventions aimed at increasing consumption of dietary iron and absorption enhancers while reducing consumption of absorption inhibitors. Greater resource allocation and commitment to evaluating the effectiveness of large-scale programs is needed.

It is widely recognized that multifactorial and multisectoral approaches to anemia control are needed in developing countries. In the terms of the health sector, it has been recommended that multiple integrated strategies be built into the primary health care system and into existing programs and services, including those focused on the integrated management of childhood illnesses, adolescent health, maternal and child health, antenatal care, safe motherhood, malaria, periodic deworming, and control of infections (WHO/UNICEF, 2004).

Systematic attention should be given to planning and implementing large-scale iron supplementation programs. These programs have not been effective because of multiple management and operational problems, such as the irregular supply and distribution of supplements, poor commitment on the part of health care personnel, a lack of adequate counseling and follow-up with respect to targeted individuals, and poor compliance.

Finally, steps should be take to strengthen the capacity of the public sector to carry out implementation, monitoring, and evaluation of program interventions such as iron/folate supplementation, periodic deworming, malaria control, and nutrition education, as well as food-based interventions. At the same time, the collaboration of the community and the private sector (both nongovernmental organizations and the commercial sector) should be enlisted to enhance the coverage and effectiveness of outreach and service delivery systems.

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