INTRODUCTION

Place matters. Where someone is born, grows up, lives, and works shapes that person’s chances of living long, living well, and living healthy. This chapter examines where the determinants of these processes and their inequities manifest themselves and how they play out (1) along the life-course. It also looks at how environmental risks, as well as individual and group vulnerabilities, vary to affect the health and well-being of the populations of the Americas.

The vast Region of the Americas is home to diverse but highly vulnerable ecosystems; the Region’s large reserves of natural habitats have been strained on many fronts. The Americas is also the world’s most urbanized region: more than three-quarters of Latin Americans live in cities, a figure that is projected to reach 85% by 2030. While cities may provide better work opportunities and
conditions and richer cultural and social circumstances for their residents than do rural areas, many urban environments can be stressed by unplanned and unchecked growth, unsafe roads and streets, housing deficits, an aging and inefficient public service infrastructure, and increasing inequities in access to goods and to public health services.

Adding to the challenges to human security and safety, an estimated 73% of the population and 67% of the health facilities in Latin America and the Caribbean are located in disaster prone areas. Over the last 30 years, at least 1 in 8 health facilities was severely affected by natural hazards that rendered it unable to continue operating, leaving more than 24 million people without access to health services for months or even years to come.

This chapter will provide an overview of the distribution of major environmental and human security risks that contribute to the unnatural causes of disease and death in the Region. The first portion of the chapter presents information on environmental changes and degradation; air quality; the availability of clean water; access to sanitation and safe waste disposal; and the production, distribution, and use of some priority chemicals. The last part of the chapter covers health threats related to the human environment and human security. These health risks in the Region are assessed in terms of the availability and distribution of safe and healthy food, trends in the nutrition status of children, employment and working conditions, the burden of violence and the vulnerability of children and women to violence, and the likelihood of becoming a victim of traffic accidents.

THE CHANGING ENVIRONMENT

Population growth and economic activities are primary drivers of ecosystem changes. These changes can trigger several mechanisms that may increase the risk of infectious disease transmission or may exacerbate conditions of vulnerability to diseases in the human population. Loss of habitat through such activities as deforestation (see Box 3.1) (2, 3, 4, 5), mainly for conversion of natural habitat to agricultural or livestock use, or urban sprawl; the alteration of surface waters through dam construction, irrigation, and stream diversion; and loss of biodiversity that may occur by overharvesting (overfishing, for example) or the introduction of invasive species that compete with predator species and change host population density are mechanisms of ecosystems change that increase the risk of disease. Examples of such increased vulnerability are malnutrition; the stress and trauma associated with floods and storms; immunosuppression that can be triggered by chemical contaminants released by agriculture, mining, or industry; and chronic inflammation of the respiratory tract caused by air pollution.

The reasons for the emergence or reemergence of some diseases are not fully known, but the following mechanisms and examples of underlying drivers have been identified as causes of change or increases in the incidence of many diseases: altered habitat, loss of biodiversity, niche invasion or host-shifting by pathogens, human-induced genetic changes in disease vectors or pathogens, and environmental contamination (6).

Examples of altered habitat include the deforestation of the Amazon that is increasing the risk of malaria, as well as extractive activities in the Amazon region, such as oil and gas exploration, that have had devastating effects on the environment and, in turn, on human health (see Figure 3.1 and Boxes 3.1 and 3.2) (3, 4, 6, 7, 8, 9, 10, 11).

Loss of biodiversity—through habitat fragmentation, the capability of key reservoir host species to expand their range in fragmented and isolated small woodlots unregulated by predators or competitors, and greater disease risk though increases in both the absolute and relative density of the primary reservoir—is influencing the occurrence and maintenance of cutaneous leishmaniasis, Chagas’ disease, Lyme disease, and LaCrosse virus in the Americas (12). Niche-invasion drivers also include human migration, international travel and trade, and accidental or intentional introduction of pathogens by humans, as is the case with influenza, SARS, and the bat-borne Nipah virus.

Pesticide application and the overuse of antibiotics are the main drivers of human-induced
genetic changes by producing resistance to pesticides in insects that are disease vectors and by triggering the emergence of antibiotic-resistant bacteria. In addition, environmental contamination due to a lack of sanitation, increased rainfall caused by extreme events linked to climate change, and the increased runoff caused by the impervious surfaces of urban sprawl have been associated with diseases such as leptospirosis and cryptosporidiosis; and the deposition of chemical pollutants such as nutrients and fertilizers in coastal areas has been associated with an increase in toxic algal blooms, an important cause of food poisoning.

**Climate Change**

Manifestations of climate change, such as rising sea levels, an increase and severity of heat waves, more frequent and more intense hurricanes and storms, severe floods and droughts, and declining air quality, particularly in urban settings, are already being observed and are expected to increase over time (13).

In the Americas, the leading health impacts from climate change are heat stress and increased levels of...
malaysia, dengue, and cholera and other water-borne diseases (14). Climate-change-induced weather disasters, droughts, environmental degradation, and diseases exacerbated by climate change may also harm food and crop yields, affecting nutrition and triggering migration and population displacement, which, in turn, may spread disease in unexpected ways (15).

The scientific evidence and the scientific community’s consensus regarding climate change are irrefutable. Based on observed increases in average global air and ocean temperatures, and the widespread melting of snow and ice and attendant rising global average sea level, the Intergovernmental Panel on Climate Change (IPCC) concluded in 2007 that the warming of the climate—which includes an increase in climatic variability—is unequivocal. Evidence from around the world demonstrates that rising temperatures are changing and disrupting the balance of natural systems that supply the basic needs of life (13, 15). The World Meteorological Organization (WMO) states that 2010 was ranked the warmest year on record, together with 2005 and 1998 (16).

The global average sea level has risen at an average rate of 1.8 mm/year since 1961, and at 3.1 mm/year since 1993 (13).
The United Nations Framework Convention on Climate Change (UNFCCC) calls for mitigation actions to reduce emissions of greenhouse gases and adaptation actions to reduce the impact of climate change on the environment and society. To be successful, both types of actions must engage all of society—civil society, industry, the governmental and other sectors—in a joint effort and must be sensitive to the region’s cultural diversity and to the need to increase citizens’ awareness about climate change and its threats. The health sector itself, as a source of greenhouse gas emissions, also can significantly contribute to both mitigation and adaptation efforts by reducing its carbon footprint and continuing its work to increase health care facility safety.

Because climate change is already affecting and will continue to affect the Americas, the region’s governments, including health-sector authorities, must adapt to such changes, in order to ready the health systems to protect the population’s health from the increased risks associated with climate change. In particular, it is important to strengthen core public health interventions in such areas as vector management, environmental health protection, and disease surveillance, and to increase the focus on environmental and socioeconomic determinants of health.

**Vulnerability to Climate Change**

Although climate change affects everyone in the Americas, the region’s at-risk populations bear the greatest brunt. Such factors as being poor and less educated; living in crowded conditions or in vulnerable environments; lacking good or enough food to eat; and not having access to good health services or early warning systems for climate-related events such as heat waves, floods, and hurricanes can singly, or in combination, dramatically increase the vulnerability to climate change.

The Region of the Americas’ high rate of urbanization also compounds the effects of climate change in various ways. For example, as migrants from the countryside flock to the Region’s cities, many settlements in urban and peri-urban sites are built on hilly terrain and usually are home to poorer residents. Poorly constructed and often clinging to unstable terrain, these settlements render their inhabitants at greater risk of being swept away by landslides and mudflows (14). And rural areas—home to many of the Region’s most vulnerable populations—face even greater risks from climate change. For instance, a national assessment found that states in Brazil’s highly rural and low-income northeast region were the most vulnerable to the negative health effects of the changing climate (14). Assessment results reflect a region of poor social indicators, a high level of climate-sensitive infectious diseases, and a semi-arid climate with periodic droughts.

The Region’s small Caribbean countries and territories are particularly affected by climate-sensitive health outcomes, including waterborne diseases and morbidity and mortality from extreme weather events (17). Furthermore, with more than half of the Caribbean population living within 1.5 km of the shoreline, rising sea levels, flooding, changes in the magnitude and frequency of storm events, and the availability of potable water are of grave concern for these populations (14).

Existing vulnerabilities in a given population affect its capacity to respond to the impacts of climate change. Consequently, identifying these groups is essential for designing and implementing effective strategies for climate change and health. In the Americas, children under 5, pregnant and lactating women, older adults, the poor, the socially excluded, indigenous populations and other ethnic groups, and displaced populations living in urban and rural areas are considered to be groups living in vulnerable situations. Their vulnerability can be exacerbated by structural stress factors, such as poverty, food insecurity, social conflict, and disease, that prevail in many communities in the Region. Moreover, the Region’s low-income countries and areas where undernutrition is widespread, education is poor, and infrastructure is weak will face the most difficult challenges in adapting to climate change and its related health consequences. Developed countries are also vulnerable, as has been demonstrated by the impacts of extreme weather events,
such as storms, floods, and heat waves, in the United States and Canada.

Climate change, extreme climate events, and disasters affect women and men differently (18). Because women in the Americas generally occupy lower socioeconomic positions, they have less access to information, less control over decisions that affect them, and less access to resources and benefits that would enable them to effectively respond to climate change and related dislocation (19). Responses to climate change must take into account these gender differences.

In the national communication reports to the United Nations Framework Convention on Climate Change, some Latin America countries presented analyses regarding the health impacts of climate change in their populations. To date, only 11 countries have reported on health impacts and these assessments are still incomplete. Table 3.1 (20) shows the distribution of climate-related diseases of concern identified in these studies.

**The Ozone Layer and Ultraviolet Radiation**

As the ozone layer has become depleted due to such factors as the release into the atmosphere of chlorine- and bromine-containing substances of anthropogenic origin, humans are increasingly exposed to higher levels of ultraviolet (UV) radiation, especially in the UV-B band, which is

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<tr>
<th>Countries</th>
<th>Malaria</th>
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<th>Respiratory diseases</th>
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*Source: Modified from Moreno, AR (20).*
particularly unhealthy. Computer models estimate that with a 10% reduction in the ozone layer in the stratosphere there could be an increase of 300,000 cases of non-melanoma skin cancer and 4,500 melanomas worldwide, and from 1.6 to 1.75 million more cases of cataracts. Cultural factors, such as longer exposure time at beaches, swimming pools, and sports activities, and less protection from clothing on hot days, for example, can increase exposure. Artificial sources used in industry, trade, and recreation also contribute to excess exposure (21).

In the Americas, exposure risks are higher in countries that are close to the equator and where people live at altitudes higher than 2,000 m above sea level, since UV radiation increases from 10% to 12% with every 1,000 m in altitude. Furthermore, people who live in areas with holes in the ozone layer are exposed to greater radiation (http://www.nasa.gov/vision/earth/environment/ozone_resource_page.html). Seasonality also has an influence, in particular summer, when radiation levels peak (21).

Excess exposure mainly affects the skin, eyes, and immune system (21). There is strong causal scientific evidence for diseases of the skin, such as cancer (malignant melanoma, squamous cell carcinoma, and basal-cell carcinoma), solar keratosis, and sunburn; for diseases of the eyes, such as cataracts, pterygia, and carcinoma of the cornea and conjunctiva; and for immune-system diseases, with the reactivation of oral herpes. The burden of disease induced by solar UV radiation is significant in the Americas. According to data from 2000, there were 11,219 reported deaths from melanoma in men and 6,744 in women, and an estimated 119 million disability-adjusted life years (DALYs) lost in men and almost 71 million in women.

Disasters and Health Protection

Almost one fourth—442 of 1,915—of the disasters that occurred from 2006 through 2010 took place in the Americas. There were 48 million people affected in the Region, or 5% of the 904 million persons affected worldwide (22). The economic impact of these disasters in the Region surpassed US$ 157 billion—or 34% of global losses—and more than half of that cost was due to tropical storms (US$ 87.698 billion).

Two major emergency events marked the 2006–2010 period for the Americas and for the world at large. The 2010 earthquake in Haiti was one of them, which ranked as the most devastating earthquake recorded in the Region of the Americas and sparked an unprecedented response and global solidarity. The other was the 2009 influenza A(H1N1) pandemic, which triggered health emergencies in several countries because of the uncertainty concerning its possible impact (Box 3.3). Extreme climatic events also increased during the reporting period, particularly floods, which have been on the rise since 2002 and have affected nearly every country of the Region (23). Severe drought also constituted an important climatic event during the period: extreme droughts occurred in Costa Rica in 1999; Brazil in 2005 and 2010; Argentina, Chile, and Paraguay in 2008; and Guatemala in 2001 and 2009. These events touched off severe food scarcity and necessitated the mobilization of international assistance. Figure 3.2 (24) shows the frequency of disasters from 1970 to 2009.
Disasters are not “natural”; rather, they result from the interaction between a hazard, natural or not, and a community’s vulnerability. Earthquakes, hurricanes, and conflicts are hazards that may or may not cause damage, depending on the community’s vulnerability. If a community is highly vulnerable, the damage may exceed its response capacity, producing a disaster. At a lower vulnerability level, a community may be able to cope with damages, causing an emergency. This interaction explains why hurricanes and earthquakes affect different populations unequally. For example, according to the United Nations, although the number of tropical cyclones detected by satellite worldwide ranged from 88.4 to 86.5 per decade between 1970 and 2010, the number of disasters caused by natural phenomena rose from 21.7 to 63 during that period (25). The percentage of countries that were stricken by cyclones increased from 14% in 1970–1979 to 45% in 2000–2010.

**The Role of the Health Sector**

The health sector is always part of the first line of response to emergencies and disasters, where one of its essential functions is to save lives, limit permanent disability, and protect the health of affected populations (26). These necessary actions can only be carried out properly if they are part of a multisectoral effort at all levels of government that is
coordinated with all health institutions. The Hyogo Framework for Action 2005–2015, endorsed by 168 United Nations Member States, commits all countries to reducing disaster risk; among its priorities for action is to include disaster reduction in the health sector and achieve the goal of “hospitals safe from disasters” by 2015 (27). According to the Global Assessment Report on Disaster Risk Reduction, between 2006 and 2010, 28 (80%) of the Region’s countries reported progress in their implementation of the Hyogo Framework for Action, although barely 40% of all signatory countries reported significant progress in reinforcing critical infrastructure, such as hospitals and schools (25).

In Latin America and the Caribbean, the population exposed to tropical cyclones increased from an average of 1.2 million people per year in 1990–1999 to 5.2 million in 2000–2010, although in low-income countries the population exposed in 2010 was eight times greater than that in 1970. The most frequent disasters in this period in the Region were those caused by floods (172) and meteorological events (154), which together represented nearly three-fourths of all events. Floods affected over 27 million people, while geological phenomena and droughts affected nearly 16 million people.

The greatest economic impact was caused by tropical storms and hurricanes that caused damages and economic losses greater than US$ 87 billion, while the cost of the impact of earthquakes was greater than US$ 40 billion. Mortality from tropical cyclones and floods is lower today than 20 years ago, except for populations who live in countries with a low gross domestic product (GDP) and deficient governance, where the number of poor who are exposed to these phenomena has increased up to eight times, response capacity is limited, and vulnerability reduction standards do not exist or are not enforced.

Children are especially vulnerable to disasters—an estimated 66 million children are affected by these events each year. According to reports, disasters decreased school enrollment in Bolivia and other countries. In extreme disasters, the gender gap increases, and fewer girls finish their primary education than do boys. Furthermore, in extreme disasters, the incidence of diarrheal diseases in children under 5 is greater than in any other population group.

Disaster Prevention and Relief

Less than 10% of the countries of the Americas with fewer than 500,000 inhabitants have a disaster program with full-time staff and its own budget allotment within the Ministry of Health, whereas all countries with over 20 million inhabitants have a full and high-level program. Half of existing health-sector disaster programs report that they never have had specific permanent financing; of those that do, one-third are allocated less than US$ 10,000 per year and only one-third receive more than US$ 100,000. Moreover, although 66% of PAHO Member Countries report that they have plans to cope with disaster situations, 88% of these plans are contingencies for concrete risks. Many countries lack national disaster plans, let alone plans to cope with multiple hazards.

In this regard, with a view to improving and systematizing disaster risk assessment procedures, in 2009 a “health-sector self-assessment tool for disaster risk reduction” was developed in the Caribbean, which is being progressively rolled out by ministry of health disaster programs in that region to measure disaster preparedness and risk reduction and to monitor interventions using established standards (28).

One of the most significant advances in disaster reduction was the development of the hospital safety index (HSI) (29), designed to rapidly sketch the probability that a health facility will continue to operate in a disaster. Although the HSI is not intended to replace detailed—and expensive—vulnerability studies, its ease of use and low cost enable countries to take an important step in prioritizing investments aimed at improving the safety of their health facilities.

By late 2010, the HSI had been applied in at least 28 countries and territories of the Americas, and its use has now spread to all other regions of the world. Of the first 419 hospitals assessed in the Region, 31% were classified at security level A (safe),
48% at level B (average safety), and 21% at level C (low safety). According to established standards, a level-A hospital has a high probability of continuing to function in a disaster and of suffering only minor damage. A level-B facility is likely to experience problems with continuing to function and will suffer moderate damage; a level-C hospital does not ensure protection of the life of patients or personnel in a disaster and, therefore, requires immediate intervention measures.

In 2010, the Center for Research on the Epidemiology of Disasters (CRED) reported that the Region had been affected by 94 events, including epidemics, floods, droughts, and earthquakes. Approximately 88% of these disasters were primarily addressed with national resources and little outside assistance. Major complex disasters, such as the earthquakes in Chile and Haiti and the outbreaks of dengue in Latin America and of cholera in Haiti, required that the affected countries resort to international assistance (Box 3.4).

At the global level, health-sector financing for disaster response increased from US$ 232 million (32% of requested funds) in 2006 to US$ 758 million (56%) in 2010. During this same period, WHO granted 41% of requested funding for humanitarian assistance in health, on average.

**AIR QUALITY**

WHO considers that air pollutants are one of the 10 chemicals of major public health concern. The most important sources of indoor pollution are related to the use of solid fuels, such as the burning of biomass and coal, and tobacco. The most important sources of outdoor pollution include motor vehicles and the use of fossil fuels in fixed sources, such as in electric power plants.

The effects of air pollution on health include respiratory infections, heart disease, and lung cancer. Scientific evidence of the effects associated with air pollution is well established in the literature, but there is no limit for “no effect” for the contaminants most studied (PM10, PM2.5, NO2, SO2, and O3). It is estimated that for every 10 μg/m³ increase in PM10 there is a 0.5% excess risk of death.

**Urban Air Pollution**

Despite the significant progress made in megacities such as Los Angeles, Mexico City, São Paulo, and Santiago, where efforts are continually being made to reduce contamination levels, there is still a great deal to be done. For example, there is a need to invest more in ongoing air quality monitoring, to search for ways to decrease emissions, to conduct research linked to the development of regional standards, and to engage civil society’s participation in the effort to decrease exposure to environmental contingencies. Most of the Region’s large and mid-sized cities, and even some country capitals such as Panama’s and Paraguay’s, do not have air quality monitoring networks. Furthermore, few countries have monitoring systems for fine particles (PM2.5), ozone, and other toxic gases, which are essential because they provide up-to-date information through computer networks. Having such systems is key for streamlining decision-making and disseminating air quality status to the general public. With this information, actions can be adopted to protect health, particularly for persons who are at greatest risk of being affected. Additionally, although many countries of the Region have a legal framework for air pollution control, prevailing standards vary widely from country to country, and some do not set limits for some parameters or use limits greater than those recommended by WHO guidelines (Table 3.2) (30, 31, 32, 33, 34, 35, 36, 37, 38, 39).

**Population Growth: Pressure on Air Quality**

The growth of large and mid-sized cities in Latin America and the Caribbean, income growth, and the global liberalization of trade in goods and services all stimulate an increase in the demand for energy and transportation. By substantially increasing the
number of fixed and mobile pollutant emitters, they constitute one of the most important drivers of pressure on the atmosphere (40).

Latin America and the Caribbean is the most urbanized region of the developing world (40). The Population Division of the United Nations Department of Economic and Social Affairs estimates that the urban population in this region increased from 77.5% in 2005 to 79.4% in 2010; it is expected to reach around 85% in 2030.

### Pollutant Emissions from Fixed and Mobile Sources

It is difficult to evaluate the different emission sources in the countries of the Americas because they differ from country to country. This variation occurs because the countries’ industrial processes are different, as is the adoption of more efficient and less polluting technologies in production processes. Moreover, there is a gap in the age of the vehicles in circulation and in motor quality. In addition, there

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**BOX 3.4. Lessons learned in the Chile, Haiti, and Japan earthquakes.**

The magnitude 7 earthquake in Haiti (2010) had a significantly lower magnitude than the earthquakes in Chile in 2010 (magnitude 8.8) and Japan in 2011 (magnitude 9), but the highly dissimilar damage these countries experienced had to do with other specific characteristics of the earthquakes as well as the vulnerability of the affected communities.

In Haiti, the earthquake was much shallower (13 km) than in Chile (35 km) or in Japan (34 km) and the distance from the epicenter to the capital of the country was 373 km in Japan, 335 km in Chile, and just 25 km in Haiti. These—and others—characteristics intrinsic to the events determined that in Haiti the maximum estimated intensity was greater than X, while in Japan it was IX, and in Chile VIII. Moreover, in Haiti over 1.16 million people were exposed to intensities of IX or X, while in Chile no locality was exposed to that seismic intensity.

Sixty-one percent of the hospitals located in the affected areas of Haiti stopped functioning due to severe damage or to the collapse of their infrastructure and, although only 5% of health centers were critically damaged, those that remained standing did not have the personnel, equipment, or supplies necessary to care for patients in serious condition. The headquarters of the Ministry of Health was destroyed, burying some 200 workers, and in addition, 19 of 47 universities and health education institutions collapsed.

In Chile, over 660 people died or disappeared in the earthquake. According to preliminary information, the economic impact was equal to 5% of the country’s GDP. With regard to health services infrastructure, it was reported that 51 (39%) of the 130 hospitals located in the regions affected by the earthquake were not damaged, 54 (45%) had slight damage and continued operating, and 25 (19%) stopped operating, 17 because of severe infrastructure damage. As a consequence, 4,249 hospital beds were lost—297 of them in critical care. Six months after the earthquake, however, 95% of the lost beds were recovered through the installation of field hospitals, purchase of services from private entities, and repairs to damaged hospitals, and rapid reconstruction of the collapsed hospitals was begun.

In Japan, 207 (54%) of the 381 hospitals and clinics in the prefectures of Kanto, Iwate, Fukushima, and Miyagi continued functioning without problems after the earthquake, while 141 (37%) were saturated and could not accept more patients. Of the other 33 (8%) hospitals that stopped operating, 26 (79%) were back in service 20 days after the event.

These three earthquakes demonstrate that the quality and protection of health services infrastructure in disasters have a direct impact on the health and life of the affected populations, and that greater development and resources in a country facilitate early recovery of health programs and services.
are also various inventory methods, which means that at present, there is no standard that makes the information compatible. According to reports from different countries, the greatest load of contaminant emissions into the atmosphere comes from mobile sources, which is why each country’s transportation policies notably influence the percentile of the contribution from the automotive sector (Box 3.5) (41).

Pollutant Trends

Taking overall PM10 measurements as a reference, and without analyzing their degree of reliability, pollutant trends seem to be decreasing. It should be pointed out, however, that from 2006 to 2010 the annual average concentration of contaminants did not meet prevailing standards in many of the countries where they were monitored (Table 3.3) (42, 43, 44, 45, 46, 47, 48, 49, 50, 51).

Disease Burden Attributed to Air Pollution

In 2008, 132,572 deaths were attributed to air pollution in the Region, including Canada and the United States, with an average of 9.4 deaths per

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<thead>
<tr>
<th>TABLE 3.2. Limits on air pollutant concentrations, selected countries of the Americas; Buenos Aires, Argentina; and the World Health Organization (WHO).</th>
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<tr>
<td>Peru</td>
</tr>
</tbody>
</table>

Sources: References (30, 31, 32, 33, 34, 35, 36, 37, 38, 39).
Note: Cells have been left blank where there are no established limits for the specific pollutant. Limits presented as found in original source.

BOX 3.5. Impact of air quality on health, Mexico.

The metropolitan area of the Valley of Mexico was the site of the first assessment of the impact of air quality on human health in Latin America and the Caribbean, as part of the area’s air quality management plan. Its objective was to estimate the number of deaths that could be prevented if atmospheric PM10 concentrations were reduced in the metropolitan area of the Valley of Mexico to i) levels established in current Mexican regulations; ii) levels recommended by the World Health Organization; and iii) levels in the guidelines of the United States Environmental Protection Agency (EPA) for the state of California. The results of the PM10 assessment showed that around 400 deaths per year would be prevented in the first scenario, 1,000 deaths in the second, and 2,300 in the third.

Source: Reference (41).
100,000 population and great variability among the countries (http://apps.who.int/gho/indicatorregistry/App_Main/view_indicator.aspx?id=2259). The lowest rates were in Barbados, Bolivia, Grenada, Saint Lucia, and Trinidad and Tobago (<1/100,000) and the highest occurred in Cuba (26/100,000) and Argentina (24/100,000). The burden of disease attributed to air pollution has also been measured in disability-adjusted life years. Based on 2004 data, the total DALYs in the Americas is 884,000 (52).

### Air Quality Programs

Although the legal framework for air pollution control in each country cannot be evaluated, the fact that public policies, programs, and action plans are in place means that some progress has been made in the Region in terms of air quality management (Box 3.6). This progress has been uneven, however, and in many cases results are still unavailable on the implementation of plans and policies presented as models. Several success stories clearly demonstrate the viability of developing and implementing policies that are aimed at reducing urban air pollution. For example, integrated public transportation systems that have been put in place in Curitiba (Brazil) and Bogotá (Colombia) have been used as models by other large cities in the Region (Mexico City, São Paulo, and Santiago, Chile) and in Europe (Bilbao and Seville). These integrated air quality management programs were implemented in Mexico’s main cities in the 1990s (40).

The effort to implement national communications on greenhouse gases has had a noteworthy impact on all the Region’s countries. As part of this initiative, several countries have worked to produce greenhouse-gas inventories, which has indirectly facilitated capacity building in the respective governmental agencies. The momentum that accompanies this type of effort should help to develop air pollution criteria and emissions inventories that are comparable and in use by all the countries, so that reliable regionwide assessments can be conducted.

All cities—particularly large and mid-sized ones—should develop efficient monitoring networks in the coming years. Furthermore, countries that have good particulate monitoring systems should also develop monitoring systems for fine particles (PM2.5), ozone, and other toxic gases. As already has been shown in some locations, these systems require adequate access to up-to-date information through computer networks if they are to contribute to and facilitate decision-making and public dissemination.

### TABLE 3.3. PM$_{10}$ concentrations, selected cities of the Americas, 2006–2010.

<table>
<thead>
<tr>
<th>Country</th>
<th>City</th>
<th>Station</th>
<th>Annual standard (µg/m$^3$)</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil</td>
<td>São Paulo</td>
<td></td>
<td>50 µg/m$^3$</td>
<td>37</td>
<td>41</td>
<td>39</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>Canada</td>
<td>Vancouver</td>
<td></td>
<td>20 µg/m$^3$</td>
<td>14</td>
<td>13</td>
<td>12</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Colombia</td>
<td>Bogotá</td>
<td>Fontibón</td>
<td>60 µg/m$^3$</td>
<td>85</td>
<td>87</td>
<td>68</td>
<td>59</td>
<td></td>
</tr>
<tr>
<td>Ecuador</td>
<td>Quito</td>
<td></td>
<td>50 µg/m$^3$</td>
<td>32</td>
<td>35</td>
<td>33</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>Guatemala</td>
<td>Guatemala</td>
<td></td>
<td></td>
<td>63</td>
<td>57</td>
<td>41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mexico</td>
<td>Mexico City</td>
<td>LVI</td>
<td>50 µg/m$^3$</td>
<td>72.5</td>
<td>76</td>
<td>81.4</td>
<td>65</td>
<td></td>
</tr>
<tr>
<td>Mexico</td>
<td>Guadalajara</td>
<td>AGU</td>
<td>50 µg/m$^3$</td>
<td>67</td>
<td>65</td>
<td>56.7</td>
<td>49.5</td>
<td></td>
</tr>
<tr>
<td>Panama</td>
<td>Panama City</td>
<td></td>
<td></td>
<td>38</td>
<td>44</td>
<td>36</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>Peru</td>
<td>Lima</td>
<td>Hipólito Unanue</td>
<td>50 µg/m$^3$</td>
<td>91</td>
<td>108</td>
<td>78</td>
<td>74</td>
<td></td>
</tr>
<tr>
<td>United States</td>
<td>Los Angeles</td>
<td>North Long Beach</td>
<td>50 µg/m$^3$</td>
<td>31</td>
<td>33.5</td>
<td>29.1</td>
<td>35.9</td>
<td>20.7</td>
</tr>
<tr>
<td>United States</td>
<td>New York</td>
<td>Queens College</td>
<td>50 µg/m$^3$</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>17</td>
<td>19</td>
</tr>
</tbody>
</table>

*Source: References (42, 43, 44, 45, 46, 47, 48, 49, 50, 51).*
**BOX 3.6. Air quality management and monitoring programs in selected Latin American countries.**

<table>
<thead>
<tr>
<th>Country</th>
<th>Program description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>In 2009, the second scientific meeting of the Integration Project for Air Pollution Mitigation was held, organized by the National Technical University. In the case of the Autonomous City of Buenos Aires, the goals set for 2010 were to obtain an air quality baseline, consolidate the inventory of fixed sources, and reduce emissions from mobile sources.</td>
</tr>
<tr>
<td>Bolivia</td>
<td>In La Paz, the Clean Air Bolivia (2006–2009) initiative, whose principal goal was to accomplish air quality management under the Municipal Strategies program, created the National Air Quality Monitoring Network Report on Phase II of the Clean Air Project (<a href="http://asocam.net/asocam/sites/default/files/publicaciones/archivos/BIBLIOTECA_0076.pdf">http://asocam.net/asocam/sites/default/files/publicaciones/archivos/BIBLIOTECA_0076.pdf</a>).</td>
</tr>
<tr>
<td>Brazil</td>
<td>The 2011 Environmental Quality Report for the state of São Paulo indicates that efforts to reduce emissions from mobile sources are continuing. The Vehicle Air Pollution Control Program (PROCONVE) has been responsible for significantly decreasing environmental impact, especially from carbon monoxide and particulate matter. Although monitoring of vehicle emission limits has been efficient, the increase in circulating vehicles has offset the amount of emissions. More restrictive limits are expected in 2014 (<a href="http://www.cetesb.sp.gov.br/ar/qualidade-do-ar/31-publicacoes-e-relatorios">http://www.cetesb.sp.gov.br/ar/qualidade-do-ar/31-publicacoes-e-relatorios</a>).</td>
</tr>
<tr>
<td>Chile</td>
<td>The Prevention and Decontamination Plan for the Metropolitan Region is being developed (Decree 66, 2010). Its objective is to prevent exposure by the population to high rates of contamination through emission control measures and mitigation during extraordinary episodes. Historic progress has been made, including the changes in particulate matter from 1997 to 2007 measured in the MACAM Network-2: for example, in 1997 there were 112 days exceeding the standard; in 2007 the standard was exceeded on 60 days; and in 2008, it was exceeded on 47 days. Furthermore, daily maximum PM10 values dropped from 317 µg/m³ to 233 µg/m³ from 1997 to 2007. The MACAM Network is the official network for Automatic Monitoring of Air Quality and Meteorology for the city of Santiago, Chile (Sinca–National Air Quality System) (Decree 66, 2010).</td>
</tr>
<tr>
<td>Colombia</td>
<td>The Air Quality Monitoring Network of Bogotá, modernized in 2008, currently has 15 monitoring stations. In addition, a plan is being carried out to control pollution by 2030, which plans to reduce emissions from fixed and mobile sources, improve the fuel produced by Ecopetrol, build “greenways,” and renew the vehicles in circulation.</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>The Program to Improve Air Quality in the Greater Metropolitan Area 2008–2013 consists of six strategic lines of action, of which the main one is protection of the health of the population. The 2007 emissions inventory has been proposed as the basis for implementation of the plan.</td>
</tr>
<tr>
<td>Ecuador</td>
<td>Ecuador is making progress with phase 3 of the Air Quality Improvement and Repair Program, in particular the strengthening of air monitoring networks in Quito and the air monitoring network in Cuenca.</td>
</tr>
<tr>
<td>Mexico</td>
<td>The National Air Quality Information System (SINAICA) collects and disseminates data produced by Mexico’s principal air monitoring networks by using the Internet. It currently compiles data from over 20 cities. Furthermore, the Program to Improve Air Quality in the Metropolitan Area of the Valley of Mexico (PROAIRE) 2011–2020 is on the verge of being launched, with specific goals and management measures aimed at controlling air quality.</td>
</tr>
</tbody>
</table>

**Household Air Pollution**

Air pollution within the home endangers human health and harms the environment. The harmful emissions from the incomplete combustion of solid fuels—including wood, agricultural residues, and charcoal (biomass), as well as coal—to heat the home and cook can result in indoor concentrations of particulate matter and gases that are 60-fold higher than those in outdoor urban air pollution (53). Women and children, who spend the greatest amount of time in close proximity to the stove, are most exposed.

The smoke from burnt biomass contains a toxic mix of fine particles, volatile organic compounds, and other pollutants that can travel deep into the lungs, putting those exposed to them at greater risk of disease and death. Indoor air pollution is the third leading environmental risk factor for death, and the second leading environmental risk factor for DALYs in middle- and low-income countries in the Americas (52). Indoor air pollution has been linked to childhood pneumonia, chronic obstructive pulmonary disease, and lung cancer; it also has been associated with tuberculosis, cataracts, and adverse pregnancy outcomes (54).

There are vast disparities between and within the Region’s countries in the use of dirty fuels for cooking, lighting, or heating. For instance, more than 50% of the population in Guatemala, Haiti, Honduras, Nicaragua, and Paraguay relies on dirty fuels. But the 16 million people in Mexico (only 14.9% of its population) and the nearly 13 million people in Brazil (only 6.7% of its population)
without access to modern fuel sources\textsuperscript{1} outnumber the populations that rely on biomass in those five countries combined. Using the latest reliable data available up to December 2011, approximately 87 million people in Latin America and the Caribbean—15.2% of the Region’s population and among them, the poorest in the Americas—burned biomass as their main fuel source (55, 56).\textsuperscript{2}

Countries with large rural populations tend to rely more heavily on biomass, with urban-to-rural disparities in access to modern fuel sources remaining large. But since many rural inhabitants do have access to modern fuels, the rate of biomass consumption cannot be merely explained by the size of a country’s rural population. For example, the percentage of rural citizens in Bolivia and Ecuador is roughly the same (35%), but while 31% of Bolivians rely on biomass use, only 5% of Ecuadorians do. In Guatemala, 30% of urban residents still cook over wood fires and 76.5% of Haiti’s urban residents still cook with charcoal (57).

While indoor smoke from the burning of solid fuels in the Region is predominantly a rural problem (see Figure 3.3), it is necessary to consider the double exposure to indoor and outdoor pollution. Part of the rural population have migrated or are migrating to large cities, where traffic is a great contributor to urban air pollution. Given the Region’s tendency of increased urbanization, it is necessary to consider the life-course exposure to indoor air pollution for this population group.

There are interventions that can reduce household emissions of air pollution from cookstoves in the Americas. The Global Alliance for Clean Cookstoves was launched precisely to achieve the universal adoption of clean cookstoves and fuels worldwide. Box 3.7 (58) presents results of an intervention study conducted in Guatemala that is gathering evidence for the need to promote the use of clean fuels and efficient stoves to reduce acute lower respiratory infections (ALRIs).

ALRIs are the leading cause of death in children under 5 years old in developing countries. If it continues unabated, the exposure to high concentrations of toxic, burnt-biomass particles in the Region may jeopardize the advances made in the Americas on chronic respiratory and cardiovascular diseases by tobacco-control policies, may erode the gains attained in child survival, and may hinder efforts towards health equity. A greater awareness of the social gradient of those who rely on biomass could help define priority areas of action, and eventually could influence national energy, housing, and cookstove policies and regulations in the coming years.

\section*{WATER AND SANITATION}

The United Nations General Assembly officially recognized access to water and sanitation as a human right by adopting a resolution in that regard (GA/10967) in July 2010. This landmark acknowledgment changes the view of water as a purely “commercial” good, instead considering water and sanitation as central to human development and dignity, as a fundamental social determinant of

\begin{figure}
\centering
\includegraphics[width=\textwidth]{figure3.3}
\caption{Biomass use as a function of the size of the rural population, Latin America, 2007.}
\label{fig:biomass_use}
\end{figure}

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|}
\hline
Country & Rural Population (%) & Solid Fuel Use (%) \\
\hline
Bolivia & 35 & 31 \\
Ecuador & 35 & 5 \\
Guatemala & 30 & 30 \\
Haiti & 76.5 & 76.5 \\
\hline
\end{tabular}
\caption{Percentage of rural citizens and urban residents using solid fuels in selected countries.}
\end{table}

\footnotesize
\textsuperscript{1} Modern fuels include electricity and gas (a growing body of scientific evidence recommends against the inclusion of kerosene as clean fuel).
\textsuperscript{2} Data for Costa Rica and Venezuela are from Rehfuess et al. (56). Data from all other countries are from WHO (55).
health, and as essential to alleviating poverty. Improving water, sanitation, and hygiene may well be the single most-effective intervention towards enhancing human health and preventing illness and death in the Americas (59).

While the Region has achieved Millennium Development Goal (MDG) 7’s target regarding sustainable access to drinking water with 90% coverage or more, and is well on its way to meeting the basic sanitation target, progress has been uneven, and significant gaps remain between and within countries. Moreover, some 38 million people (7% of the Region’s total population) (60) still lack access to improved drinking water sources, and the population covered by systems with adequate surveillance and quality control for water in particular, and by drinking water and sanitation systems in general, is limited in urban areas and even lower in rural areas. In 2001, it was estimated that only 24% of Latin America and the Caribbean’s urban population had access to systems that monitored for water quality, and only 13.7% of residual wastewater collected by sewerage systems was treated (61). More than 117 million people in Latin America and the

**FIGURE 3.4. Prevalence of the population using improved drinking water sources, Latin America and the Caribbean, 2008.**

Use of improved drinking water sources, Latin America and the Caribbean, 2008


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**BOX 3.7. RESPIRE**: Guatemala’s Cookstove Study.

Between October 2002 and December 2004, in the San Marcos region of Guatemala, 534 households with a pregnant woman or a young infant were randomly selected to receive a woodstove with chimney (n=269) or to remain as controls using open woodfires (n=265). The San Marcos population is primarily an agricultural indigenous population living between 2,200 and 3,000 m above sea level.

Although a 50% reduction in indoor emissions was achieved by the group using the cookstove with the chimney (2.2 ppm to 1.1 ppm), the levels achieved still correspond to about 80 μg/m³ of PM$_{2.5}$, which has been associated with respiratory morbidity in children. The study also reports exposure overlap between intervention and control groups, because of outdoor-pollutant concentrations.

There were significant reductions in the intervention group for fieldworker-assessed, physician-diagnosed, and respiratory-syncytial-virus-negative pneumonia. Among children younger than 18 months, there was a significant reduction (30%) of severe pneumonia, which has great implications for public health.

When considering exposure levels, and not only the chimney intervention, the study reveals a significant exposure-response relationship regarding physician-diagnosed childhood pneumonia, which contributes to causal inference and suggests that stove or fuel interventions producing lower average exposures than chimney interventions are needed to substantially reduce pneumonia in populations heavily exposed to emissions of biomass fuel air pollution.

Source: Reference (58).

1 Randomized Exposure Study of Pollution Indoors and Respiratory Effects (RESPIRE), funded by the National Institute of Environmental Sciences.
Caribbean do not utilize improved sanitation facilities; of these, 36 million still defecate in the open air (unimproved sanitation sources) (62). Figures 3.4 and 3.5 show the percentage of the Latin American and Caribbean population that uses improved drinking water and sanitation facilities.

Latin American and Caribbean countries and territories made significant gains in providing access to improved water and sanitation sources between 1990 and 2010: more than 162 million persons gained access to improved water sources and 154 million gained access to improved sanitation. Moreover, most Latin American and Caribbean countries improved their water source coverage rates to more than 75%, and many reached rates of more than 95%. These advances notwithstanding, at this juncture some countries lag in the process to reach MDG 7’s basic sanitation target, including Argentina, Bolivia, Colombia, Haiti, Nicaragua, and Panama (60).

While the Region’s overall average rate for the use of improved water sources is 94% and for improved sanitation technologies is 80%, coverage between and within countries varies greatly. For example, 17% of Haiti’s population has access to improved sanitation sources and 69% has access to improved drinking water sources (WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation). Moreover, in every country of the Americas there are significant coverage inequalities between rural and urban areas.

Most countries also face serious water-quality problems, mainly as a consequence of deficiencies in the operation and maintenance of services (60). Although surveillance of drinking water is crucial to preserving human and environmental health, it is not sufficiently incorporated into the Region’s regulatory bodies for water and sanitation, nor is it part of assessing whether water sources are improved or unimproved.

Many urban residents lack access to water and sanitation services because of the Region’s rapid and unchecked urban growth, which has outpaced the capability of city authorities to provide services to the new residents.

Diseases Related to Water and Sanitation

According to a WHO report on the global burden of disease based on data for the year 2004, 59,000 deaths in Latin America and the Caribbean were attributable to illnesses linked to water, sanitation, and hygiene. Most of these deaths occurred in Brazil, but the highest mortality rates linked to water, sanitation, and hygiene occurred in Bolivia, Guatemala, Honduras, and Nicaragua (between 0.03–0.05/100,000 deaths). In the Caribbean, Haiti faced the highest mortality rates due to these factors, at 9.1 per 100,000.

Infant mortality rates in children under 5 years of age are highly correlated to access to improved water sources and sanitation facilities in the Region (85% and 90%, respectively). As shown in Figures 3.6 and 3.7 (62), small improvements in water and sanitation produce large impacts on child survival among those in the extremely low coverage range.

Figures 3.8 and 3.9 show that deaths in children under 5 years old and maternal deaths are disproportionately concentrated in countries within...
the lowest percentiles of population having access to these services (health concentration index of −0.2817 and −0.2672, respectively), underscoring the critical importance of improving access to water and sanitation as a way to boost health equity. In fact, more than 40% of all deaths in children under 5 years old and of maternal deaths in the Americas in 2008 were concentrated in the 20% of the population that had less access to sanitation and water, respectively.
Clearly, even small improvements in the coverage of water and sanitation services could reduce mortality rates in children under 5; even greater reductions could be achieved by combining interventions in both areas. For example, interventions that only target water supply have been shown to have the lowest effectiveness. Interventions that focus on water quality, on the other hand, are the most effective in reducing rates of morbidity and mortality related to diarrhea, especially among children under 5 years old, achieving reductions of 30%–40%. Water-quality interventions are particularly effective at the household level where water is actually consumed (59).

Interventions directed at improving hygiene also have been shown to reduce diarrheal disease by 30% or more, and improvements in hand-washing have significantly reduced diarrhea when populations have access to clean water sources. Improved sanitation also has reduced diarrhea by 30%–40%, reaching reductions of up to 60% in situations of extreme vulnerability (59).

The main economic benefit of water and sanitation interventions is the time saved that would have been spent in accessing improved water sources and sanitation facilities, which represents 80% of those economic benefits. Recognizing access to water and sanitation as a human right is an important first step toward ensuring universal access, but more inclusive policies to translate this human right into practice are still to be developed and implemented in most countries in the Region (59).

Old Problems, New Risks

Open-air burning of municipal solid waste and the incineration of waste produced by health facilities without adequate control equipment are sources of gases, particles, and vapors that are hazardous to health. Populations exposed to these gases tend to experience respiratory tract problems, skin infections, and even more serious conditions. Moreover, if waste is not sorted prior to burning, as is common in open-air garbage dumps and in rural areas, incinerated wastes frequently lead to diarrhea and parasitic infections that, among other effects, increase the incidence of child malnutrition. Furthermore, the improper handling of solid waste produced by health facilities endangers the health of patients and health workers, as well as the workers at municipal disposal sites.

The quantity and composition of refuse vary from location to location, depending on economic development, income level, predominant activity sectors, consumption patterns, population size and density, and extent of urbanization. In this regard, there is a relationship between the generation of this waste and the human development index (HDI), which combines economic activity values with health and education levels. As can be seen in Figure 3.10 (63, 64), countries with a low HDI produce less solid waste, as is the case of Bolivia and Guatemala, while those with a higher HDI, such as Argentina and Chile, produce more.

SOLID WASTE: LESS VOLUME AND MINIMAL RISK

It is widely known that poor solid waste management harms people’s health and the environment in multiple ways. If not handled in accordance with established sanitary standards for storage, collection, transportation, and final disposal, this waste can help trigger diseases such as dengue, leptospirosis, gastrointestinal disorders, respiratory problems, and skin infections. These conditions proliferate among populations lacking basic sanitation services, and
plastics, batteries, and other industrial waste can produce dioxins and furans, two toxic and carcinogenic substances. According to national inventories of dioxin and furan emissions in Latin America and the Caribbean, in Argentina, Colombia, Cuba, Paraguay, and Uruguay nearly half of the emissions of these contaminants can be attributed to the indiscriminate burning of household waste. Although the entire population feels the effects of the mismanagement of solid waste, vulnerable populations who are poor or who live in unplanned urban areas suffer the most.

**Waste Management Successes and Challenges**

Several Latin American countries—Argentina, Brazil, Costa Rica, Mexico, and Paraguay—have enacted national waste framework legislation. These laws ban the use of unregulated dumps and require that national, state, and municipal governments establish solid waste treatment plans with recycling goals and programs. All these laws emphasize issues such as waste assessment, source separation programs, recycling programs, and the financial sustainability of services as leading concerns in the new trends in waste management in Latin America and the Caribbean.

In any event, from 2002 to 2010, the Region’s countries undertook important efforts that have allowed them to make significant progress in urban solid waste management, by increasing coverage rates for collection service and final disposal (63). For example, while the urban Latin American and Caribbean population increased by 63 million during this period, over 111 million city dwellers had access to waste collection services for the first time. With this increase, the proportion of the urban population in the Region who had access to sanitary solid waste collection grew from 25% in 2002 to more than 50% in 2010, that is, 167 million additional people. Many of the new sanitary landfills that were constructed were partially financed by carbon credits from the recovery and burning of methane gas at these landfills, as well as through the sale of recovered energy.

Street sweeping coverage in Latin America and the Caribbean increased from approximately 72% in 2001 to 82% in 2010. In 2010, collection coverage reached 93.4% of the population, with an increase of over 10 percentage points with respect to 2002, when only 81% of inhabitants had this service. However, although the majority of countries have coverage levels higher than 80%, especially in major localities and mega cities, there are peripheral areas or neighborhoods where the service is poor or not available.

Although these are important achievements, it should be noted that they were not evenly attained in every country nor in every city, and that in urban areas, 45.6% of the population does not have access to appropriate means of solid waste disposal. The progress recorded from 2002 to 2010 is also related to a significant increase in expenditures by cities in solid waste management. Thus, improvement in street sweeping, collection, transfer, and final disposal services resulted in an increase in the per-ton management cost, which rose from US$ 47 to almost US$ 67 in the same period. Cost recovery for these services continues to lag, since cities subsidize some 50% of real invoicing.

Achievements in public cleaning, collection, and final disposal services notwithstanding, some waste management activities remain incipient in Latin America and the Caribbean and pose major challenges. The Region is still slow in areas such as reduction of urban waste production and in selective collection, composting, materials recycling, and thermal waste treatment with energy recovery.

**Chemical Risks: The Unintentional Legacy**

We live with and depend on chemicals for our daily life. They can greatly improve our quality of life, health, and well-being. But depending on where and how they are used, and on their capacity to produce harm, they also can harm our health and the environment. Chemical safety is achieved by identifying all sources of exposure and taking measures to protect human health and the environment.
throughout the cycle of naturally occurring or manmade chemicals, from production, through transport, use, and final disposal.

Some chemicals are persistent pollutants that enter the food chain, presenting characteristics of bioaccumulation, bioconcentration, and biomagnification. Others, such as metal mercury, become more toxic when transformed into their organic form by a living organism. This section provides examples of old and emerging problems related to chemical safety.

Not all of the Region’s countries have reliable surveillance systems of intoxications and poisonings, which makes it difficult to estimate the burden of disease related to chemicals.

There are 132 poison centers in the Americas that are open to the public 24 hours. They are not evenly distributed throughout the Region, however, nor does every country have one. The Region also has informal networks of toxicologists and poison centers, but formal collaboration agreements between countries are still incipient. More structured and collaborative networks and surveillance systems could eventually help to improve chemical safety.

**Pesticides**

There are no safe pesticides. Exposure to any of the commonly used pesticides—including phenoxyherbicides, organophosphates, carbamates, and pyrethrins—has been associated with adverse health effects, with different latency periods for the different classes of pesticides (65). Health problems and fatalities are frequently associated with occupational exposure and accidental or intentional poisonings (as shown in the following subsection). Chronic exposure, however, is a widespread risk in the Americas, as a result of ingesting pesticide residues in food and, possibly, in drinking water. Estimates of individual exposure and risks are limited, as most countries do not have a permanent monitoring system of pesticide residues in food or water. Since 2001, however, Brazil has been monitoring pesticide residues in food, and now the country has a national program that monitors samples from most of the states. In 2009, 3,132 samples collected from 20 types of food in the market were analyzed, and 914 (29.2%) presented some irregularity. The most prevalent problem was the presence of non-authorized pesticides for the type of crop (23.7%), followed by those that presented residues higher than the legal limit for crop-authorized pesticides (2.7%), and that presented residue levels above the legal limits for pesticides non-authorized for the crop (2.7%).

Although guidance and legal frameworks on the use, management, proper storage, trade, and handling of pesticides are available from international organizations and international conventions, the Region’s countries have been slow to translate these guidelines into policies and practice (66). Governments have the responsibility to regulate pesticide availability, distribution, and use (67), but the legal framework in the countries tends to be fragile, and enforcement is limited by insufficient resources and laboratory capacity. Control over a pesticide’s full cycle, up to the final disposal or elimination of containers and residues, and including the rational use and control of resistance to the chemical, requires sophisticated registration and control systems that are frequently unavailable or limited in many of the Region’s countries.

Box 3.8 (68, 69) presents a case study of renal failure of unknown etiology in Nicaragua that affected young adults, mainly agricultural workers. This condition is an example of the yawning health inequities that have been tied to environmental exposures and risks through ecologic studies. 

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3 There are 60 poison centers in the United States; 38 in Brazil; 8 in Mexico; 6 in Canada; 5 in Argentina; 2 each in Venezuela and in Trinidad and Tobago; and 1 in Chile, Costa Rica, Cuba, Ecuador, Guatemala, Jamaica, Nicaragua, Paraguay, Peru, Puerto Rico, and Uruguay.

4 Pineapple, lettuce, rice, bananas, potatoes, onions, carrots, beans, oranges, apples, papayas, strawberries, sweet peppers, cabbage, tomatoes, grapes, kale, beets, and cucumbers.

5 An ecologic study (or an aggregate study) is a type of research in which the unit of observation is a group of people rather than an individual person.
Pesticides: Their Impact on Workers’ Health

Pesticide use is widespread and on the rise in conventional agriculture and agribusiness in Latin America and the Caribbean. The magnitude and severity of its impact on health has yet to be documented in the Region due to a lack of structured reporting and surveillance mechanisms in every country. In developed countries, the annual incidence of acute pesticide poisoning in farmers is 18.2 per 100,000 workers (70). Table 3.4 (71, 72, 73, 74, 75, 76, 77) reports on the number and rate of reported acute pesticide poisonings (APP) in the official registries of various countries of the Americas, and shows figures for occupational APP. The records show a considerable difference in the average rates of occupational APP in different countries. Brazil and Chile, for example, report average occupational APP rates of 25.5% and 57% of all reports for 2005–2009, respectively, while the APP rates per 100,000 workers in the two countries during the same period were 8.7 and 57, respectively. That said, these data should be taken with extreme caution, since in Brazil, for example, for each case reported an estimated 50 are not (78).

In Nicaragua, a national survey conducted in 2008 estimated some 66,000 APP cases, with an incidence rate of 3.9% in men, 0.8% in women, and 2.3% in the population over 15 years of age; 90% of these cases were from occupational exposure. Considering the agricultural population alone, the incidence increased to 6.7% (79). Other studies found greater APP in children and adolescents, with incidences between 1 and 4.7 per 100,000 population—i.e., around 18,520 cases in children 5–14 years old—although the persistent underreporting cannot be overlooked (80, 81).

In the state of Mexico most APP were found to be caused by organophosphate compounds. It also was found that underreporting there was due to workers’ lack of awareness of the risks, and that workers did not seek medical care for symptoms of mild poisoning (82).

In Central America, 33 million kg of active ingredients were imported each year between 1977 and 2006, representing a 33% increase in the entry into these countries of 403 pesticides during the period. Thirteen of these products—accounting for 77% of total imports—were considered to be the most toxic, including the so-called “dirty dozen.”
Costa Rica has been the greatest consumer of these products (83).

Using the CAREX-database methodology,6 Blanco-Romero and colleagues (84) found that workers were mainly exposed to paraquat/diquat, mancozeb/maneb/zineb, and chlorothalonil in Costa Rica, and to paraquat, methamidophos, and chlorpyrifos in Nicaragua and Panama, with higher rates in Panama probably because of the greater number of agricultural workers. Other countries, such as Brazil and Colombia, are establishing their own CAREX to orient decision-makers and their public health policies.

The Use of Pesticides in Public Health

Vector control programs in the Americas use pesticides to combat diseases such as dengue, malaria, Chagas’ disease, filariasis, and leishmaniasis. Pesticides are also widely used to control pests in households. Without effective pesticide-management systems in place, however, the risks these substances pose to the public’s health could well undermine their benefits. As stated in WHO’s strategy of integrated vector control management, it is essential for countries to routinely monitor and report on the type of pesticide, quantity used, and targeted vectors for each application to ensure that the chemical is used judiciously, that insecticide resistance is avoided, and that risks to human health and the environment are minimized (85).

A WHO report on trends in use of insecticides for controlling vector-borne diseases shows that the Region of the Americas accounted for 56% of the global use of pyrethroids, in terms of tons of active ingredient (a.i.), and far outdistanced other regions in the per capita use of pyrethroids (0.4 g a.i. per capita) and of organophosphates (0.8 g a.i. per capita). Pyrethroids are generally used for residual spraying and larviciding, while organophosphates are used for space spraying in dengue and malaria control. Carbamate use was insignificant in comparison with other classes of insecticides, and organochlorine (DDT) was only reported to be used in Ecuador, Guyana, and Venezuela in small quantities up to 2001. Pyrethroids are by far the most used insecticides in spray coverage (area covered with pesticide), which increases the pressure for developing resistance in vector populations in the Region (86).

According to results of a WHO global survey (87, 88), 24 of the Region’s countries have a legal framework on pesticides, but in 3 of them the legislation does not cover pesticides used in public health. In several countries it lacked such basic

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6 CAREX (from CARcinogen EXposure), a database developed with backing from the Europe against Cancer Program of the European Union, provides information on exposure and number of workers exposed, by country, carcinogen, and industry.
chemical-safety provisions as labeling, storage, transport, and final disposal of leftovers. Only 14 of the Region’s countries reported having national laboratories to control the quality of pesticides, and 19 reported having high or moderate concern over the quality of the products on the market. Many countries did not have any national statistics on the production and trade of pesticides or on poisoning incidents. And, whereas most countries have statistics on the import of pesticides, only a few have controls over local production and export.

In terms of the protection of health workers who work with pesticides, not all countries mandate the use of protective personal equipment, and only six report having a certification scheme for workers who apply pesticides. Only 44% of the Region’s countries report monitoring the exposure of health care workers who apply pesticides; 60% of the countries monitor pesticide poisoning in general.

These results point to critical deficiencies in the legal and regulatory frameworks in the countries, as well as in the capacity of pesticide-related law enforcement in the Americas. Some subregions have begun to harmonize pesticide registration. Multi-country registration schemes that increase the capability to register pesticides or that decrease the cost and time for quality control and law enforcement remain non-existent, however.

Although the WHO’s Pesticide Evaluation Scheme (WHOPES) recommendations are known to all of the Latin American and Caribbean countries, only two rely on them as their sole basis for registration; some include them as part of the requirements. Most countries in the Americas rely on PAHO strategic funds to acquire pesticides, which should ensure some measure of quality control of the purchased product; nevertheless, it is not clear what percentage of the total amount of pesticides used for vector control in the Region is actually bought using this arrangement.

Between 2009 and 2011, as part of a WHOPES project, Ecuador and Guatemala conducted situation analyses designed to identify knowledge gaps and needs, and developed action plans for the sound management of pesticides in public health. Brazil, among other measures, strengthened legislation to prevent the reuse of containers and ensure that vendors have final disposal plans in place before being certified to sell pesticides.

Sound management of public health pesticides will further require political commitment, policy support, and generation of national and international resources to enhance national capacity, raise awareness, promote information exchange, and enhance work sharing and collaboration.

Eliminating DDT in the Americas

DDT is one of the persistent organic pollutants (POPs) that the Stockholm Convention has slated for eventual elimination. Every Latin American and Caribbean country or territory save for Aruba, French Guiana, Grenada, Guadeloupe, Haiti, Martinique, and Suriname has ratified the Stockholm Convention.

Under the auspices of a United Nations Environmental Program (funded by the Global Environment Fund and coordinated by the Pan American Health Organization) a project was conducted in 202 communities in 8 of the Region’s countries to demonstrate the use of sustainable alternatives to DDT for malaria vector control that included environmental interventions and the involvement of municipal governments and community participation. Selective vector control, strengthening of epidemiological surveillance, and timely treatment of the sick led to a 63% reduction in malaria cases in the demonstration communities between 2004 and 2007, and an 86.2% reduction in malaria cases caused by the parasite Plasmodium falciparum. One of the project’s objectives was to identify and eliminate remaining DDT stocks in participant countries. Mexico identified and incinerated 87,900.50 tons of DDT, while Belize, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and Panama together have packed for long-term storage 96,503.70 tons of DDT, and other obsolete pesticides. There are obsolete pesticide stockpiles,

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7 Funded by the Bill and Melinda Gates Foundation.

8 Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, and Panama.
including stores of DDT, that still exist in the Region and need to be safely disposed of to ensure that the public’s health is protected.

**Mercury**

Mercury is a powerful neurotoxicant that can damage the brain and the nervous system. Pregnant women and young children can be particularly damaged by exposure to mercury. Mercury contamination can lead to developmental problems such as learning disabilities and delayed onset of walking and talking.

Metallic mercury is used in a mercury-gold amalgam that makes it easier to extract the gold; when the amalgam is fired, it emits mercury into the atmosphere. As the amalgam is subsequently purified at gold shops, untreated air from this process, which is highly charged with toxic elemental mercury, is released into the environment (89). Aquatic microorganisms can convert metallic mercury released in the environment into methylmercury, the element’s most toxic form. Several studies in the Americas, especially in the Amazon region, showed high levels of mercury in fish.

Mercury may also occur naturally in the Region (90, 91), but it mainly wreaks havoc on human health as an introduced contaminant in the environment. Almost all mercury pollution is produced by coal-fired power plants and other industrial processes, which spew mercury into the atmosphere, from where it rains down to settle on soils and freshwater and saltwater sources, sometimes hundreds of miles away from the source. Forest burning, dam construction, and agricultural and pastoral activities accelerate the mobilization of soil and sediments, and may increase the process of methylation of the metallic mercury.

In Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Suriname, and Venezuela, metallic mercury emissions and methylmercury residues pose major environmental health problems for populations living in and just outside the Amazonian ecosystem. According to the Amazon Cooperation Treaty Organization (ACTO), 2,500 tons of mercury have been released in Brazil alone during the last 25 years. Studies developed by Brabo (90) and the review from Passos and Mergler (2008) have pointed to several areas in use or that have been used in the past for artisanal gold mining in this region.

The potential extent of mercury exposure and contamination in the Americas underlines the critical need to develop clinical studies to evaluate health effects, especially longitudinal studies to observe possible changes in the patterns of mercury exposure and related health effects. Methodologies and technologies to prevent new emissions of mercury into the environment also must be put in place.

The use and waste management of mercury in health care practices also deserves attention. Most health care use of mercury occurs in dental clinics and vaccines, but mercury is also present in thermometers, sphygmomanometers for blood pressure monitoring, baumanometers, gastroesophageal dilator tubes, barometers for respiratory therapy, and intraocular pressure devices. A two-year report of initiatives for mercury-free health care practices from the WHO Global Initiative to Substitute Mercury-Based Medical Devices and Health Care Without Harm (HCWH) noted that national policies related to mercury in health care have been issued and are being implemented, and as of May 2010 more than 1,945 hospitals from Argentina (1,722), Brazil (162), Chile (16), Costa Rica (5), and Mexico (40) were in the process of switching, or have already substituted, their mercury thermometers and blood pressure devices to mercury-free devices (92).

**Lead**

Lead is particularly detrimental to children because a child’s intestine absorbs lead much faster than an adult’s and their developing central nervous system is more vulnerable to toxic agents. This is particularly true for malnourished children. Lead impairs neural

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9 Thiomersal is an organic mercury compound used as a preservative in multi-dose vaccines to prevent fungal and bacterial contamination. There is no evidence of health risks associated with the presence of thiomersal in vaccines.
proliferation, differentiation, and plasticity. If untreated, lead poisoning in children damages the brain and nervous system, and may lead to behavioral and learning problems such as hyperactivity, slowed growth, hearing problems, and headaches. Exposure to lead may occur by inhalation or ingestion, by touching surfaces contaminated with lead and then touching the hand to the mouth, and by putting lead-contaminated objects into the mouth, all of them being typical behavior in children that increases exposure. Children with low-level exposures are often asymptomatic and, as a result, may be undiagnosed and untreated.

The elimination of lead in gasoline in the Region has greatly decreased overall exposure. Still, in 2004, an estimated 7,000 deaths were attributable to lead intoxication in the Americas (52). Children, especially those living in low socioeconomic environments, may be additionally exposed to unacceptable lead levels by living in industrial neighborhoods or near battery recycling, smelting, or mining sites. Additional risks are posed by contaminated paint, as well as contaminated candies, dishes, toys, and jewelry.

Despite the considerable body of evidence provided by studies undertaken in developed countries, there are no reliable data on routine surveillance and very little research available on lead levels in children in most countries of the Region. Periodic monitoring of blood lead levels is part of national programs on children’s health in the United States, but there is a lack of information on the overall distribution of blood lead levels in children in Latin America and the Caribbean. Box 3.9 (93, 94, 95, 96, 97, 98, 99, 100) gives an overview of lead contamination in children in the Region.¹¹

Lead production in the Region remains virtually unchanged, with Mexico, Peru, and the United States ranking among the world’s five leading lead producers. Efforts must be directed towards screening children at high risk for lead poisoning, and towards identifying and controlling sources of lead exposure.

**Eradicating Asbestos**

Chile and Argentina were the first Latin American and Caribbean countries to ban the use of asbestos (2001 and 2003, respectively), although limitations remain on the control of asbestos exposure in older buildings. Honduras and Uruguay banned it in 2004, although Uruguay continues to import industrial asbestos gloves and asbestos-cement sheets. In Brazil, considerable asbestos mining persists in the state of Goias; it has been estimated that more than 240,000 workers are exposed to it in asbestos-cement and brick production plants. In other states, such as São Paulo and Rio de Janeiro, its use is banned.

There are no fully reliable data concerning mortality from diseases caused by asbestos, mainly due to underdiagnosis of mesothelioma, the most common cancer caused by asbestos exposure. In Mexico, for example, barely 29% of deaths from mesothelioma are recorded on death certificates. It is estimated that the real incidence of mesothelioma in Mexico hovers between 400 and 500 cases per year (101); it should be pointed out that for each mesothelioma case, 2.3 cases of asbestos-related lung cancer are reported. In Chile, 57 mesothelioma cases were reported in 2008 (102).

**Conditions for Human Security and a Healthy Environment**

Health is an essential element of human security and, conversely, chronic insecurity can bring with it severe and ongoing threats to health. Human security in itself is also affected by diseases such as influenza A(H1N1), HIV/AIDS, tuberculosis, and cholera. The United Nations Commission on Human Security identified ensuring “universal access to basic health care” as a priority policy for human security. In its broader definition, human security

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¹⁰ Mortality attributed to selected risk factors considered individually (52).
¹¹ These results cannot be summarized in a meta-analysis because the studies differ much in design and methodology, and the search process was not comprehensive to include all possible sources of information.
<table>
<thead>
<tr>
<th>Country</th>
<th>Findings</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil</td>
<td>The mean blood lead level (BLL) in 64 children (0–16 years old) from an economically deprived community in Rio de Janeiro (Bauru) was 5.5 ± 2.39 μg/dL; 5% of the children had levels &gt; 10 μg/dL. Based on environmental indicators, it was estimated that the neurological risk factor was 549 times higher than the reference dose for inhaled lead in dust and 554 times higher for ingested lead. In addition, the estimate of the carcinogenic risk factor for ingestion was about four times higher. A study among volunteers from the same Bauru area found a link between high lead levels in surface dental enamel and antisocial behavior in adolescents.</td>
<td>Mattos et al. (93)</td>
</tr>
<tr>
<td>Chile</td>
<td>In 1996, a rural community in the country’s south suffered massive poisoning caused by contaminated flour that came from a mill whose grinding stone had been repaired with lead. Ten years later, a cross-sectional study was conducted in the area, involving 77 persons aged 10 to 25 years old, who had been poisoned and had been treated with calcium ethylenediaminetetraacetic acid (EDTA). Those younger than 6 years old at the time of exposure presented lower IQs.</td>
<td>Coria et al. (95)</td>
</tr>
<tr>
<td>Mexico</td>
<td>In 1999, there was a remediation process in Mexico’s northern portion around a smelting plant that had been documented as a “hot spot” since 1977. Among performed activities, the most important was the removal of more than 100,000 kg of dust containing high concentrations of metals in streets, highways, roofs, and houses. In addition, more than 100 families from the neighborhood presenting the highest levels of lead pollution were relocated to other places, far away from the smelter. A radius of 3 km of the center to the smelter complex was included in the program. The State Ministry of Health opened a multiprofessional clinic to follow up the lead contaminated population. An assessment of the impact of the intervention was done with a five-year cohort of children. Blood tests were done at the study beginning (n = 598), with 6 (n = 517), 12 (n = 481) and 60 months (n = 43) of follow-up. Start age was 7.2 ± 3.33 and average end of follow-up age was 12.2 ± 0.34. The timeline showed that the mean blood lead level at startup was 10.2 μg/dL and progressively lowered to 4.4 μg/dL after five years, at the end of the follow-up. The percentage of children presenting blood lead levels &gt; 10 μg/dL decreased from 50.84% to 5.6%. Although the blood lead values have decreased, there are still 5.6% of children with blood lead levels &gt; 10 μg/dL.</td>
<td>Vega-Dienstmaier et al. (97)</td>
</tr>
<tr>
<td>Peru</td>
<td>Among children under 6 years old living in slums of Puerto Nuevo, El Callao, Peru, 93.4% presented blood lead levels of 10 μg/dL or higher. The country’s main port is the likely contamination source, where lead-containing mineral deposits for export are stored. In 2006, a governmental study showed that 66.2% of children residing along the Corrientes River in Peru’s Amazon Basin had blood lead levels of 10 μg/dL or higher. The elevated blood lead levels in these remote communities were surprising due to the absence of known sources of exposure such as proximity to lead-using industries or automobile exhaust (lead gasoline). In 2008, in order to clarify the lead exposure source and overcome the limitations of the previous study, blood lead levels were determined and compared between communities exposed and non-exposed to oil exploitation activities. The mean blood lead level of the 361 capillary blood samples was 9.4 μg/dL (range: 3.3-31.6 μg/dL). There was no significant difference in mean blood lead levels between exposed (9.5 μg/dL) and non-exposed (9.2 μg/dL) communities to the oil activity. The study was not conclusive regarding the source of lead exposure.</td>
<td>Anticona el al. (98)</td>
</tr>
<tr>
<td>United States</td>
<td>National surveys found a consistent decline in blood lead levels during a 16-year period (1988–2004), with the prevalence of high BLL (≥ 10 μg/dL) decreasing from 8.6% in 1988–1991 to 1.4% in 1999–2004. Lead poisoning disproportionately affects racial and ethnic minorities and the poor. Other major risk factors for elevated blood lead levels include age, living in older houses, and being non-Hispanic black.</td>
<td>Jones et al. (99)</td>
</tr>
</tbody>
</table>
| Uruguay | In a review on lead contamination in Uruguay, the following information was presented:  
- Analysis of the results of blood lead levels collected up to 2001 of 333 exposed children (living either in the surroundings of polluted smelters or near high traffic areas where leaded gasoline was used, or had families working with lead at home) showed that average BLL was 15.7 μg/dL, and that 60% of the children had BLL values that exceeded the intervention level of 10 μg/dL.  
- Average BLLs of randomly sampled children were: in a control group (n = 112), 9.4 μg/dL, and 30% presented values > 10 μg/dL; in an exposed group of children living in the neighborhood of an iron and lead scrap smelter (n = 62), 11.8 μg/dL, and 59% had values > 10 μg/dL; and in four sibling children whose father recycled batteries at home, 38.5 μg/dL, 41.6 μg/dL, 32.2 μg/dL, and 28.1 μg/dL.  
- In the neighborhood case of La Teja, a low-income neighborhood of Montevideo, the data presented show that children’s blood lead levels decreased significantly from an average of 9.9 μg/dL to 5.7 μg/dL between 1994 (60 children; average age 5.2 years) and 2004 (180 children; average age, 6.3 years); the percentage of children with BLLs > 10 μg/dL dropped from 41.7% in 1994 to 6.7% in 2004. Both populations were sampled at the same health care center and under similar conditions. Possible contributors to the decrease were phasing out leaded gasoline in the country, replacing lead water pipes with plastic ones, increasing awareness of lead risk, and promoting changes in nutrition and hygiene habits. | Mañay et al. (100) |
includes economic, food, health, environmental, community, personal, and political security (Human Security Now). This section describes risks related to the human environment that affect human health and security, as well as aspects of human security that directly affect health but that cannot be described or measured as physical or chemical hazards, but rather by the contexts where these risks play out.

**FOOD SECURITY**

The 1996 World Food Summit defined food security as existing “when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life.” Food security is built on having enough food available on a consistent basis, sufficient resources to obtain appropriate foods for a nutritious diet, knowledge of basic nutrition to make appropriate food choices, and access to adequate water and sanitation to guarantee food safety.

Food security is a key factor to maintaining good health and preventing acute and chronic malnutrition. While factors such as food shortages caused by extreme weather events, delays in the importation of food, greater than normal variation of food prices, and the global economic crisis can affect the entire population, they immediately expose the extreme vulnerability of population groups that are already overburdened by chronic stress mechanisms, leaving little space for resilience. In a vulnerable system, even small changes in food availability may be devastating.

In Latin America and the Caribbean, food insecurity is chronic, fueled by the severely skewed income distribution. It is also foreseen that people who face food insecurity will account for a large share of urban growth, because the migration from rural areas will further stress compact urban environments.

Food-insecure persons increased by more than 14% in the Region between 2007 and 2008, which resulted in a rise from under 28% to more than 31% of food-insecure people, and a 30% increase in the distribution gap. This translates into more widespread and more intense food insecurity. One of the direct causes for this exacerbation is the large dependency on imports—which makes it difficult to shield consumers from rising grain prices—aggravated by the economic losses occurred by declining terms of trade. If no concerted effort is undertaken to reduce poverty in the long run (by 2018), food insecurity in Latin America and the Caribbean is projected to remain close to current levels (as assessed in 2009), affecting about 33% of the population (by 2018). Table 3.5 shows a significant increase in the percentage of individuals and households reporting food insecurity in the United States (having to skip meals, worrying about not being able to supply food for the family, etc.) in 2008 and 2009 when compared to 2006 and 2007 that has been associated with the economic crisis that occurred in that period.

**FOOD AND NUTRITION**

Nutrition-related diseases and conditions continue to burden the populations in the Americas. Many children and adults in the Region continue to suffer from undernutrition and micronutrient deficiencies. These conditions largely result from poverty, with the poor increasingly accessing low-cost, energy-dense foods that are high in fat, sugar, and salt (103). Whether undernourished or overweight, the poor bear the greatest burden both in relative and absolute terms.

In order to reduce both undernutrition and diet-related chronic diseases, the underlying quality of the diet must improve. To that end, food policies must address those food-security aspects that will...
improve the diet of those who bear the greatest brunt—the poor, minorities, women, and young children. Effective protective measures and policies also must cover unfair international trade agreements, the commerce of unsafe products, and the impact of agriculture policies on health, including the regulation of the production, trade, commerce, marketing, distribution, availability, and affordability of food products and the guarantee of reliable consumer information.

**Growth in Young Children**

Although it is declining, **stunting** continues to be the most prevalent form of growth failure in the Region. Children in the Americas are born close to the standard and show slight faltering throughout the first five years of life (104). About one-third of Bolivia’s and one-fourth of Ecuador’s children continue to be stunted; one in two Guatemalan children is stunted (Table 3.6). Alarming as these data may seem, national averages mask increasingly wide disparities within countries when looked at in terms of determinants such as income, rural or urban residence, and ethnicity. Stunting varies widely from country to country; age-specific risk patterns for stunting, though, are similar, highlighting the fact that the first two years of life are a critical window of opportunity for improving nutrition.

The rates of **overweight and obesity** in early childhood are rising fast, indicating that the tendency toward overweight (105) in children puts them at higher risk for later onset of chronic diseases.

**Breastfeeding**

Newborns put to the breast within the first hour after birth are less likely to die during the neonatal period (106, 107). But although nearly all newborns,

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>Stunted (height-for-age, &lt; −2 SD)</th>
<th>Underweight (weight-for-age, &lt; −2 SD)</th>
<th>Wasted (weight/height, &lt; −2 SD)</th>
<th>Overweight/obese (weight/height, &gt; 2 SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>2006</td>
<td>8.0</td>
<td>2.1</td>
<td>1.3</td>
<td>10.4</td>
</tr>
<tr>
<td>Bolivia</td>
<td>2008</td>
<td>27.1</td>
<td>4.3</td>
<td>1.4</td>
<td>8.5</td>
</tr>
<tr>
<td>Brazil</td>
<td>2006</td>
<td>6.8</td>
<td>2.2</td>
<td>1.5</td>
<td>7.3</td>
</tr>
<tr>
<td>Chile</td>
<td>2010</td>
<td>2.0</td>
<td>0.3</td>
<td>Not reported</td>
<td>9.6</td>
</tr>
<tr>
<td>Colombia</td>
<td>2010</td>
<td>13.2</td>
<td>3.4</td>
<td>0.9</td>
<td>4.8</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>2008–2009</td>
<td>5.6</td>
<td>1.1</td>
<td>1.0</td>
<td>Not reported</td>
</tr>
<tr>
<td>Dominican Republic</td>
<td>2007</td>
<td>10.7</td>
<td>5.9</td>
<td>1.2</td>
<td>Not reported</td>
</tr>
<tr>
<td>Ecuador</td>
<td>2006</td>
<td>25.8</td>
<td>6.2</td>
<td>2.3</td>
<td>5.3</td>
</tr>
<tr>
<td>El Salvador</td>
<td>2008</td>
<td>19.2</td>
<td>5.5</td>
<td>1.0</td>
<td>6.0</td>
</tr>
<tr>
<td>Guatemala</td>
<td>2008–2009</td>
<td>49.8</td>
<td>13.1</td>
<td>1.4</td>
<td>Not reported</td>
</tr>
<tr>
<td>Haiti</td>
<td>2005</td>
<td>30.1</td>
<td>19.2</td>
<td>10.3</td>
<td>4.1</td>
</tr>
<tr>
<td>Honduras</td>
<td>2008–2009</td>
<td>30.2</td>
<td>8.7</td>
<td>1.4</td>
<td>5.9</td>
</tr>
<tr>
<td>Mexico</td>
<td>2006</td>
<td>15.5</td>
<td>3.4</td>
<td>2.0</td>
<td>7.6</td>
</tr>
<tr>
<td>Nicaragua</td>
<td>2006–2007</td>
<td>23.0</td>
<td>2.3</td>
<td>2.3</td>
<td>5.7</td>
</tr>
<tr>
<td>Panama</td>
<td>2003</td>
<td>23.7</td>
<td>5.3</td>
<td>1.6</td>
<td>Not reported</td>
</tr>
<tr>
<td>Paraguay</td>
<td>2010</td>
<td>14.9</td>
<td>5.8</td>
<td>6.5</td>
<td>Not reported</td>
</tr>
<tr>
<td>Peru</td>
<td>2010</td>
<td>23.2</td>
<td>4.3</td>
<td>0.7</td>
<td>8.5</td>
</tr>
</tbody>
</table>

**Source:** Unless otherwise indicated, nationally representative surveys.

1 Data from Chile and Paraguay include children < 6 years of age and are from health service surveillance reports; therefore, they are not nationally representative.
including those born by cesarean section, can be put to the breast within the first hour of life, the proportion who are ranges from 26% to 76% in Latin America and the Caribbean (Table 3.7). Exclusive breastfeeding for the first six months of life is the most effective intervention to prevent child mortality (108); it also is among the recommended WHO/UNICEF Key Family Practices. As practiced in Latin America and the Caribbean, however, exclusive breastfeeding falls well below WHO’s six-month recommendation. The rate of continued breastfeeding at 1 year (defined as the prevalence of breastfeeding between 12 and 15 months of age) varies in this region, with Chile, Cuba, the Dominican Republic, and Mexico showing the lowest prevalences and Bolivia, Guatemala, and Haiti showing the highest.

National programs that support breastfeeding have been successful. The WHO/UNICEF Baby-friendly Hospital Initiative, which certifies hospitals as being “Baby Friendly” based on a 10-step assessment established to enhance breastfeeding, also has been widely implemented throughout the Region. In addition, most countries in the Americas have ratified the International Code of Marketing of Breast-milk Substitutes, although only Bolivia, Brazil, Costa Rica, the Dominican Republic, Ecuador, and Guatemala have issued regulations that permit the application of the law (109).

Micronutrients

Micronutrient deficiencies have grave consequences for health; given the magnitude of their prevalence,

<table>
<thead>
<tr>
<th>Country</th>
<th>Year</th>
<th>Early initiation of breastfeeding (within first hour of birth)</th>
<th>Exclusive breastfeeding under 6 months</th>
<th>Continued breastfeeding at 1 year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>2010</td>
<td>Not available</td>
<td>55.0</td>
<td>60.0</td>
</tr>
<tr>
<td>Bolivia</td>
<td>2008</td>
<td>56.3</td>
<td>60.4</td>
<td>84.6</td>
</tr>
<tr>
<td>Brazil</td>
<td>2006</td>
<td>42.9</td>
<td>38.6</td>
<td>47.5</td>
</tr>
<tr>
<td>Chile</td>
<td>2009–2010</td>
<td>Not available</td>
<td>62.7 (E)</td>
<td>35.5</td>
</tr>
<tr>
<td>Colombia</td>
<td>2010</td>
<td>61.6</td>
<td>42.7</td>
<td>58.5</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>2006</td>
<td>Not available</td>
<td>18.7</td>
<td>Not available</td>
</tr>
<tr>
<td>Cuba</td>
<td>2006</td>
<td>Not available</td>
<td>26.4</td>
<td>24.7</td>
</tr>
<tr>
<td>Dominican Republic</td>
<td>2007</td>
<td>59.7</td>
<td>7.7</td>
<td>33.6 (E)</td>
</tr>
<tr>
<td>Ecuador</td>
<td>2004</td>
<td>26.4</td>
<td>39.6</td>
<td>62.0</td>
</tr>
<tr>
<td>El Salvador</td>
<td>2008</td>
<td>32.8</td>
<td>31.4</td>
<td>73.3</td>
</tr>
<tr>
<td>Guatemala</td>
<td>2008–2009</td>
<td>55.5</td>
<td>49.6</td>
<td>78.6</td>
</tr>
<tr>
<td>Haiti</td>
<td>2005–2006</td>
<td>39.7</td>
<td>40.7</td>
<td>76.8</td>
</tr>
<tr>
<td>Honduras</td>
<td>2005–2006</td>
<td>71.9</td>
<td>29.7</td>
<td>72.4 (E)</td>
</tr>
<tr>
<td>Mexico</td>
<td>2006</td>
<td>Not available</td>
<td>22.3</td>
<td>37.1</td>
</tr>
<tr>
<td>Nicaragua</td>
<td>2006–2007</td>
<td>76.3</td>
<td>30.6 (E)</td>
<td>67.9</td>
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<tr>
<td>Panama</td>
<td>2009</td>
<td>Not available</td>
<td>27.7</td>
<td>Not available</td>
</tr>
<tr>
<td>Paraguay</td>
<td>2008</td>
<td>31.2</td>
<td>24.4</td>
<td>Not available</td>
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<tr>
<td>Peru</td>
<td>2010</td>
<td>42.2</td>
<td>63.9</td>
<td>71.6</td>
</tr>
<tr>
<td>Uruguay</td>
<td>2006–2007</td>
<td>60.0</td>
<td>57.1</td>
<td>43.5</td>
</tr>
<tr>
<td>Venezuela</td>
<td>2007–2008</td>
<td>Not available</td>
<td>27.9</td>
<td>Not available</td>
</tr>
</tbody>
</table>

E = estimated.
Source: All data are abstracted from nationally representative surveys or ministry of health reports.
they significantly affect human development and economic productivity in the Region. The prevalence of anemia is 44.5% in young children under 5 years of age (22.5 million), 30.9% in pregnant women (3.5 million), and 22.5% in women of reproductive age (31.7 million) (110). Iron-deficiency anemia puts women at particular risk, in that it increases their chances of dying from blood loss during delivery and contributes significantly to maternal mortality (111).

The Region’s countries have instituted policies designed to address conditions related to micronutrient deficiencies, such as night blindness and ocular injuries because of vitamin A deficiency (112); neural tube defects (NTDs) because of folic acid deficiency (113); and iodine deficiency disorder (IDD), the most common cause of preventable brain damage, cretinism, and mental retardation, as well as endemic goiter and hypothyroidism.

The Epidemic of Nutrition-related Chronic Diseases in the Americas

Several national surveys conducted in Latin American and Caribbean countries (from the World Health Organization Global Database) show that between 50% and 60% of adult men and women in the Region are overweight and obese, similar to the figures seen in the United States (according to the Centers for Disease Control and Prevention). Moreover, 7% to 12% of children under 5 years old are obese, which is a figure six-fold greater than that for undernutrition in the same age group. National surveys conducted in Mexico and Chile in 2006 show that some 15% of adolescents are obese.

Dietary patterns in most Latin American and Caribbean countries are changing significantly: there is a clear decrease in the consumption of fruits, vegetables, whole grains, cereals, and legumes, coupled with an increase in the consumption of foods rich in saturated fat, sugars, and salt (such as milk, meats, refined cereals, and processed foods). Simultaneously, Latin American and Caribbean populations have decreased their physical activity, leading to rising levels of overweight and obesity.

Environmental factors contribute in powerful ways to drive individual behavior, and economic, marketing, and cultural dynamics help shape a population’s eating patterns and preferences. Urban design and policies guiding transportation and safety must be put in place so that for those living in the Region’s cities, the healthy choices are the easiest choices. An environmental approach is increasingly being recognized as a key strategy for tackling the noncommunicable disease epidemic. The battle to reduce the intake of unhealthy foods is a multi-pronged approach, involving, among other strategies, implementing governmental incentives to boost local production and consumption of healthy foods, rather than focusing agricultural production on exports; pricing healthy foods so they can compete with mass-produced high-energy and low-nutrient processed foods; harnessing the State’s power as a large food purchaser to promote better diets in schools, hospitals, and public offices; enacting legislation to restrict food advertisements targeted at children and levying taxes on processed foods (such as snacks and sweetened beverages); promoting urban vegetable gardens in schools and parks; and upholding national and regional dietary and cooking traditions on cultural and public health grounds. Improving the food environment is all the more important given that the impoverished populations in the Americas are the ones bearing the greatest burden of noncommunicable diseases and the ones most vulnerable to undernutrition and overweight/obesity because of poor dietary quality and limited opportunities for physical activity.

Food Safety

Food safety is determined by the presence or absence of chemical or biological contaminants in sufficient concentration to harm health. The public health impact can be even more significant when access to a complete and healthy diet is limited. Foodborne diseases (FBDs) have been recognized by WHO to be a major global public health problem (Resolution WHA63-REC1). FBDs are responsible for a burden of disease that has a high social and economic impact, particularly in the most disadvantaged countries (114).
PAHO has had a Regional Information System for FBD outbreaks in Latin America and the Caribbean since 1993. A study of FBD outbreaks reported by 22 countries from 1993 to 2010 found that of the 9,180 outbreaks where the causative agent was identified, 69% were bacterial, 9.7% viral, 9.5% caused by ocean toxins, 2.5% chemical contaminants, 1.8% parasites, and 0.5% vegetable toxins. Although data on FBDs are limited by underreporting, they are extremely important for guiding public prevention policies (115).

Few countries in the Americas have implemented FBD surveillance systems. The work of the Centers for Disease Control and Prevention (United States) is noteworthy, where a critical methodology for evaluating the burden of FBDs has been emerging. Some population-based studies in Latin American and Caribbean countries also have helped to estimate the burden of FBDs in the Region.

In Cuba, based on a survey conducted in 2005 (during the rainy season) and 2006 (during the dry season), the general prevalence of acute gastroenteritis was estimated at 10.6%. A similar study in Chile in 2008 found a monthly age-adjusted diarrheal disease prevalence of 9.2%, while the acute gastroenteritis incidence rate was 0.98–2.3 episodes per year per person—rates similar to those reported in Canada and Cuba and somewhat higher than those in Argentina and the United States (116). In Argentina, another study that relied on the same design, done in 2007 in Gálvez, Santa Fe, found prevalences of 0.76 and 2.7 episodes of acute gastroenteritis per person per year for the dry and rainy seasons, respectively (116). Finally, in the English-speaking Caribbean, a range of 0.56 to 2.45 episodes per person per year has been reported. Age, occupation, type of health care system, sewerage system, and use of antibiotics were all identified as significant predictive factors for cases of acute gastroenteritis. All these studies are clearly elucidating structural determinants (e.g., ethnicity, gender, education, migration, trade, urbanization, demographic factors, and poverty) that are expressed in different modes of food consumption, handling, and production that produce inequality in relation to food safety reflected in different levels of exposure and disease (http://whqlibdoc.who.int/publications/2010/9789241563970_eng.pdf).

A recent paper by Pires and colleagues (115) that focused on 22 countries of the Americas found that the number of outbreaks reported by different countries varied considerably depending on the capability of each country’s food surveillance system, with Cuba reporting the most with an identified etiology, followed by Mexico. Among foods with the greatest impact on gastroenteritis cases in the last 10 years, eggs have been responsible for 8.6% of reported episodes, followed by oil and sugar (5.4%), vegetables (4.4%), and grains and beans (3.5%). Salmonella, Vibrio parahaemolyticus, and Shigella spp were the most common causative agents. The study also found that the most important sources of salmonellosis were eggs, meat (especially chicken and pork), and vegetables. These estimates are in line with the conclusions of source attribution studies from elsewhere in the world (115). The Pires et al. study also found variations in the period analyzed that could be explained by changes in consumption habits, in foodborne disease control, in animal production systems, and in food production methods.

**Employment and Working Conditions**

The International Labor Organization (ILO) estimated that nearly 468 million people were working in the Americas in 2011: 283 million (60.5%) in Latin America and the Caribbean and 185 million (39.5%) in North America. There are, however, vast inequalities in employment (e.g., contracts, wages, and social protection) and labor conditions in the Region, resulting from the nature and processes of work. These conditions are fundamental determinants of health and the differences in their distribution have a broad impact on health, quality of life, and equity (117).

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12 This research, supported by the Danish Food Institute and the WHO Department of Food Safety (http://www.who.int/foodsafety/en/), used a regional database of FBD outbreaks and cases maintained since the early 1990s by PAHO/WHO.
Working Conditions in the Region

Occupational health services are limited and poorly developed in most of the Region’s countries, which at least partially explains the underdiagnosis and underreporting of occupational diseases. This means that both the type and magnitude of exposure to hazards are estimated on the basis of characteristics inherent in the type of jobs that people do—hence, the importance of “working conditions and health surveys,” which serve as tools for planning and evaluating worker health policies. These surveys show that, in general, all workers are exposed to multiple hazards of different natures and they explain the profile of worker morbidity, accident, and mortality rates.

In fact, in several countries occupational diseases are still intermingled with statistics for on-the-job accidents or are simply not detected. The ILO and PAHO/WHO recognize that the leading cause of underreporting has its root in health professionals’ ignorance of professional pathologies. However, this deficit is also due to the fact that statistics on occupational risks do not include the self-employed or the economy’s urban and rural informal sectors. Additional obstacles include the negligence of employers—who refuse to report health events related to the work environment or who intimidate and harass workers who report them—and the ignorance of workers about the dangers to which they are exposed. Finally, this epidemiological reality coincides with the countries’ recognition of shortcomings in their occupational disease surveillance, detection, and registry systems.

Formal Work and Precarious Work

During the previous decade Latin America and the Caribbean solidified a stable macroeconomic framework, reinforced by relatively high average economic growth rates—around 6% per year—and a near-25% increase in the GDP from 2002 to 2011 (118). This economic growth, which enabled countries to alleviate the effects of the recent world economic crises and continue to move forward with their socioeconomic equity agendas (118, 119), was not uniformly distributed across this region, since certain countries—such as Mexico and some Central American and Caribbean countries—experienced below average growth.

Although the workforce is the driver of economic growth, the strengthening of employment as a generator of wealth was limited. According to data from the Economic Commission for Latin America and the Caribbean (ECLAC), most of the jobs created in 2009 were in the service sector (61.6%), followed by the industrial sector. The agricultural sector, traditionally one of the most dynamic, also showed signs of weakening, with a job creation rate of one for every six workers. Formal hiring of employees was 49%, predominantly in urban areas (59%) and among males (63.7%) (119). The ILO, in turn, reports that from 2000 to 2010, there was a slight downturn in unemployment rates. During the 2009 global crisis, unemployment grew by around 1 million people and 12 million became poor due to the fall in GDP (118).

Other studies show that, even with the reduction in unemployment, underemployment and unemployment persist in both rural and urban areas, more heavily affecting young people aged 15 to 24 years, whose rate of unemployment—17.3% in 2009 and 16.1% in 2010—is nearly threefold higher than the overall average in the Americas. Furthermore, the number of new jobs is insufficient, as is their quality, which is much lower than the expectations, wages, and social benefits corresponding to those entering the formal market. Thus, so-called precarious work is gaining, which rapidly leads to uncertainty, lack of motivation, and finally abandonment of the job, unleashing a vicious cycle that further erodes the labor situation. The Region has not invested enough in human capital, which has led to low educational levels and limited skills in the workforce; physical assets (machinery and technology) also are insufficient (118). As a result, it is expected that from 2011 to 2012, growth will decline to 4.5%. All of these factors have led to an expansion

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13 Precarious employment is formal work in a place where labor laws are not observed.
of precarious work in the Region, increasing the fragility of employment relations, affecting everyday work (120), and potentially creating direct and indirect effects on workers’ health (121).

**Informal Labor**

Despite the aforementioned economic recovery, Latin America and Caribbean countries have not been able to reverse the informalization of labor seen in recent decades. This is because countries that have experienced a rapid recovery and an uptick in employment have increased part-time employment and volunteer work, pushing many workers into the informal market.

The most recent ILO survey (2011) on employment in the informal economy in middle- and low-income countries establishes a clear difference between (1) employment in the informal sector, understood as unrecorded work carried out in small businesses that are unregistered or lack official recognition, and (2) informal employment that includes jobs without legal protection or social benefits that can be found in the formal sector, the informal sector, or in homes.

In its January 2010 *Global Employment Trends* report, the International Labor Organization (ILO) defines vulnerable employment as “the sum of own-account workers and contributing family workers.” Because monitoring this can help show trends in the overall quality of employment, an increase in the proportion of vulnerable employment clearly indicates that the frequency of informal employment agreements has increased, keeping workers in precarious labor conditions, with low wages, excluded from social protection, and subject to violations of other rights and social benefits.

The report also observes that not only is Latin America and the Caribbean one of the three regions with the greatest amount of vulnerable employment in the world, but also that because of the crisis, an additional 1.59 million people are working under these conditions. In this regard, the countries that have the highest rates of informal employment and of people employed in the informal sector,14 in 2011 are Bolivia (75.1% and 52.1%, respectively), Honduras (73.9% and 58.3%), Peru (70.6% and 50.2%), Paraguay (70.7% and 37.9%), Nicaragua (65.7% and 54.4%), Ecuador (60.9% and 37.3%), and El Salvador (66.4% and 53.4%) (122). A study conducted in 16 Latin American and Caribbean countries reports that vulnerable employment continues to be present, to a greater or lesser extent, throughout the region and that 53.8% of employed non-agricultural workers are working in the informal sector.

**Child Labor**

Child labor is defined differently among the Region’s countries. As a result, child labor is generally considered to be work done by a child or young person who is younger than the legal age for working in his or her respective country. Child labor encompasses all productive activities, whether or not there is a relationship of subordination, a wage relationship, or whether it is part time or full time, occasional, regular or seasonal, or legal or illegal (123).

Currently, there are 10.7 million children under 15 years old who are working in Latin America and the Caribbean, with Peru (42.2%), Bolivia (27.4%), and Guatemala (21%) showing the highest rates (123). These girls and boys work an average of 18 to 30 hours a week and 9.4 million of them are engaged in dangerous activities, mainly in the agriculture sector and in the streets of large cities (Box 3.10) (124, 125, 126, 127, 128, 129, 130, 131, 132).

Another scourge involves the worst forms of child labor in high-risk activities, such as sexual exploitation, conscription into the military or militias, and other activities resulting from the trafficking of children and young people. The ILO states that the use, procurement, or offering of a child for prostitution, for the production of pornography, or for pornographic performances is one of the worst forms of economic exploitation (122). In Latin America and the Caribbean, it was estimated that in 2008, 228 girls and boys were sexually

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14 Excluding informal work in rural areas.
exploited every hour. The Program for the Eradication of Child Labor (PETI) in Brazil is a successful example of public policy, which made it possible to reduce the number of working children by nearly three million from 2003 to 2007 (133). This experience demonstrates that the situation can be rapidly changed, and that the way to do so is to focus national actions and programs that include education, monitoring, and legal coercion on the culture of exploitation of child labor (Box 3.11) (134).

Forced Labor

Forced labor, the antithesis of decent work, victimizes those who are the least protected: women, children and young people, indigenous people, and migrants. It is estimated that some 1.3 million people in Latin America and the Caribbean currently work under these conditions. This practice has been detected in many formal and informal economic activities, and in urban and remote rural regions. It is related to the abusive practices of slavery, semi-slavery, servitude, and debt bondage, all of which are legally punishable in every country in the Region. The ILO suggests that debt bondage and servitude largely affect temporary, rural, and indigenous workers. Forced labor in Latin America and the Caribbean is closely linked to economic heterogeneity and to patterns of inequality and discrimination, particularly

BOX 3.10. Environmental health of children.

The environment plays a very important role as a determinant of the health and well-being of children. For children to be able to develop to their full potential, it must be ensured that they are born, grow, and develop in environments with clean air, clean water, safe food, and minimal exposure to harmful chemicals (133).

Environmental hazards affect children differently than adults. Prenatal exposure to chemicals can exert a critical influence on epigenetic changes. Some effects of prenatal exposure can manifest early (e.g., birth defects), others later in childhood (e.g., childhood cancer), and others tend to appear in adulthood or even in the following generation.

Among the specific physical and physiological characteristics of children is that their skin is more susceptible, especially in newborns, their immune system is immature, their airways are partially developed before 8 years of age, and their brain and reproductive system finish developing in adolescence, and each of these characteristics determines which chemicals and other contaminants have more opportunities to interfere with cellular reproduction processes. That children weigh less, their bodies are developing and, proportionally, they drink more water, eat more food, and breathe more air than adults are also implicated in their greater vulnerability. Their levels of exposure to hazards also increase because of behavior typical of their age, such as putting their hands in their mouths and playing closer to the ground. As expected, the highest environmental exposure of children often occurs in communities that face multiple social and economic stress factors.

Childhood exposure to some of the “traditional”1 and “modern”2 hazards and the child labor situation are described in more detail in other sections of this chapter. Examples of exposure to hazards not mentioned elsewhere are polycyclic aromatic hydrocarbons from wood smoke in indigenous communities and brickyards in marginalized urban areas; the presence of organochlorines in the blood of children in malarious regions where DDT was used for vector control; and heavy metals in metallurgical, mining, or petrochemical industry areas.

1 These include unhealthy water, deficient sanitation, indoor air pollution, lack of food hygiene, poor quality dwellings, inadequate waste disposal, and proliferation of disease vectors.

2 These include high levels of lead or mercury, climate change, depletion of the ozone layer, electromagnetic radiation, presence of persistent organic pollutants, and endocrine disruptors.

Source: References (124, 125, 126, 127, 128, 129, 130, 131, 132).
against the most socially unprotected and vulnerable populations.

**Women and Work**

The increase of almost 20 million workers in Latin America and the Caribbean over the last decade is largely attributed to the massive entry of women into the labor market (135). The sustained increase in their participation is irreversible, as indicated by the increase in the female employment rate from 47% to 52.8% of the economically active population from 2000 to 2010 (136). The Organization of American States’ Inter-American Commission of Women (136) reports that, overall, women remain at a disadvantage vis-à-vis men in terms of social and economic development indicators, except in higher income countries where there is no illiteracy and that have greater primary and secondary education. Poverty is a barrier to women’s access to education and the acquisition of labor skills, as is the sexual division of labor that assigns them the obligation of caring for the home, children, and other dependents. These factors limit women’s access to better job opportunities (Table 3.8) (135).

Women continue to enter the workforce in economic activities that mirror the traditional roles of the family and the home, since for every four working women, three work in the service sector, most of them informally (135). Domestic work, historically acknowledged to be among the occupations with high levels of informality (11.9% of paid employment in the Region), is primarily undertaken by women—according to some sources, it accounts for 26.6% of female paid employment. In Brazil, only around 25% of these women workers had a formal employment contract in 2005, which means that those who worked informally—nearly 4.6 million domestic employees—had no access to social benefits. This group of workers also was found to be more vulnerable to hazards such as sexual and moral harassment and abuse, mistreatment, and physical violence. Gender inequities are also reflected in the distribution of housework in the home. In Bolivia, Chile, Ecuador, Guatemala, and Mexico, women who do housework surpass men in proportions from 13.1% to 38.8%. Social class and ethnicity also reinforce gender inequities. According to some studies, female workers in maquiladoras (foreign-owned assembly plants) in Mexico tend to be migrants with low educational levels and in much need of work. Consequently they are forced to accept unfavorable employment and working conditions, such as irregular contracts, long working hours, low wages, sexual and physical harassment, and limitations related to pregnancy and lactation. Despite countless studies on women’s labor conditions undertaken in the Region and globally that have made these problems visible, the efforts rolled out to resolve them in Latin America and the Caribbean, and even in industrialized countries, have not made significant changes. Researchers initially categorized these problems early in the decade, and advanced studies on gender equity done as part of the ILO’s Decent Work Agenda continue to ratify them (2006) (Table 3.9) (135, 136, 137, 138, 139, 140).

**BOX 3.11. Child street-laborers.**

Pinzón-Rondón et al. (134) interviewed 584 boys (68.3%) and girls (31.7%) aged 5 to 17 years (average 11.8 years) who worked on the streets of Bogotá, Lima, Quito, and São Paulo, exposed to chemical, biological, physical, and ergonomic hazards. The study also included serious psychosocial hazards, such as street violence, sexual abuse, persecution by the authorities, the presence of drug traffickers, and trafficking of minors. Of the children interviewed, 39.6% had suffered an injury—scratches (19.5%), wounds (16.4%), burns (8.6%), traffic accidents (8.9%), sprains (4.6%), and amputations (0.3%). They worked some 46 hours per week (39 during the day and 7 at night). It was estimated that the greater the number of hours working in the street, the greater their risk was for having an accident.
In order to address this complex problem, several international organizations (including PAHO/WHO, the ILO, and OAS) have launched various initiatives aimed at mainstreaming gender equity in the workplace and lending visibility to the work of women health caregivers and women who work in rural areas. Furthermore, the invisible barriers to women’s work are also considered a challenge for labor conciliation within companies.

**Progress towards Workers’ Health Equity**

The Region’s countries have welcomed and promoted many disease-elimination initiatives of international cooperation agencies that also make it possible to mitigate the occupational disease burden. Strategic partnerships have been forged to advance joint activities with an interinstitutional and multipartite approach aimed at tackling workers’ health problems.

Within this framework, national or regional occupational health commissions or committees have been formed in more than 22 countries. One example is the Initiative for the Elimination of Silicosis in the Americas, whose programs to eradicate this ailment are already being implemented in Brazil, Chile, and Peru, and have also begun to be carried out in Argentina, Colombia, Mexico, and Uruguay (141). Another is the Health Worker Protection Program in the Region, which has already vaccinated 350,000 workers against hepatitis B and provided training on the prevention of needle stick accidents in order to prevent the effects of biological hazards in the workplace in Argentina, Bolivia, Costa Rica, Guyana, Haiti, Jamaica, Panama, Peru, Uruguay, and Venezuela, as well as in nine countries of the English-speaking Caribbean (141).

The current challenge is to study and address workers in the informal sector of the economy in urban and rural areas, as well as to strengthen occupational health services integrated into primary health care, so that they help solve the problems of the workers in this sector.

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**TABLE 3.8. Unemployment, labor force participation, and employment rates (%) for men and women, selected countries of Latin America, 2010.**

<table>
<thead>
<tr>
<th></th>
<th>Unemployment</th>
<th>Participation</th>
<th>Employment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>6.5</td>
<td>71.1</td>
<td>60.5</td>
</tr>
<tr>
<td>Women</td>
<td>9.1</td>
<td>49.9</td>
<td>41.4</td>
</tr>
</tbody>
</table>

*Source: Reference (135).*

**TABLE 3.9. Problems women face in the job market, Latin America and the Caribbean.**

<table>
<thead>
<tr>
<th>Category</th>
<th>Situation</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Occupational segregation or labor market segmentation</td>
<td>Women are pigeonholed into a few “traditional” occupations (stereotyping) that pay lower wages, have low productivity, and offer no social protection coverage.</td>
<td>ILO (135)</td>
</tr>
<tr>
<td>Instability or lack of opportunities</td>
<td>Women do not have job security and accept jobs that are short-term, part-time, and without guarantees. (Men tend to have more job opportunities.)</td>
<td>Abramo (137)</td>
</tr>
<tr>
<td>Barriers to advancement, or glass ceilings</td>
<td>Women stagnate in positions without being able to progress because of barriers built into the job structure (e.g., schedules or goals), policies, or leadership styles of the company.</td>
<td>OAS/CIM (136)</td>
</tr>
<tr>
<td>Underemployment and unemployment</td>
<td>If paid, wages are below their skills and responsibilities, or they end up confined to working in domestic service or other jobs in the informal economic sector.</td>
<td>OAS/CIM (136)</td>
</tr>
<tr>
<td>Low paid or unpaid</td>
<td>Women earn less than men, with a greater gap at higher educational levels, or they are unpaid, e.g., caregivers in the home, domestic service workers, or rural family workers.</td>
<td>PAHO (138)</td>
</tr>
<tr>
<td>Sexual or psychological harassment and incidental violence</td>
<td>Women submit to their harasser for fear of losing their jobs, or hide and tolerate violent situations (family violence) to avoid their impact on the job.</td>
<td>CEPAL (139)</td>
</tr>
<tr>
<td>Multiple responsibilities and roles</td>
<td>Women must juggle many, difficult to reconcile, obligations in the home, at work, in the family, and in the community.</td>
<td>Borrelli and Artazcos (140)</td>
</tr>
</tbody>
</table>

*Source: Based on the category of universal problems of Latin American and Caribbean women, as defined by several authors.*
Urban Violence

Violence is a public health problem. It is the leading cause of death and injury in persons 15 to 44 years old, and causes billions of dollars in medical care expenditures and in losses from missed workdays. According to a study by the Inter-American Development Bank (IDB), Latin American households in cities with more than one million inhabitants have a 70% greater probability of suffering violence compared to households located in cities of 50,000 to 100,000 inhabitants. Even in predominantly rural countries, a high proportion of violence is concentrated in urban areas. In Guatemala, for example, approximately 40% of the homicides committed in 2006 took place in the capital city, where a mere 20% of the country’s population lives. Nevertheless, the relationship between urbanization and violence is not always linear or consistent, since there are rural areas with rates of homicides and other types of violence that are higher than in urban areas. In this regard, a WHO study documented that levels of violence against women were consistently higher in rural areas in 10 countries of the world. Elsewhere, rural areas might register higher levels of violence when they are strategic areas for organized crime activities, such as drug trafficking. An example of this duality in the predominance of violence between the urban and rural context is the city of San Salvador, where in 2005 and 2006 the homicide rate was lower than the national average, with a difference close to 40 homicides per 100,000 population.

Socioeconomic Costs of Urban Violence

In addition to the multiple consequences for the health of its victims, violence results in important financial and social costs. Violence consumes considerable portions of the budgets allocated to the health, social, and judicial sectors due to costs related to the treatment of survivors and to the apprehension of assailants. A 2010 World Bank report estimates that the financial costs of violence in Central America alone amount to US$ 6.506 billion, equivalent to 7.7% of that region’s GDP and to 10.8% of El Salvador’s GDP. In all the Central American countries, health expenditures (medical care, loss of productivity, and emotional care) from violence total more than 50% of that amount (US$ 3.351 billion). The additional financial burden from health expenditures resulting from violence was 6.1% of El Salvador’s GDP and 1.5% of Costa Rica’s.

Role of the Health Sector in Violence Prevention

Even though violence has always existed, the world need not accept violence as an unavoidable aspect of the human condition. The health sector plays an essential role in multisectoral violence-prevention strategies. Its role ranges from efforts to quantify violence—assessing its impact and its risk and protection factors—to attempts to mitigate its consequences through early intervention together with individuals who have suffered it. In its eight-part series of briefings, “Violence prevention: the evidence,” WHO emphasizes seven strategies that have been identified as effective in preventing multiple forms of violence:

1. Developing safe, stable, and nurturing relationships between children and their parents and caregivers.
2. Developing life skills in children and adolescents.
3. Reducing the availability and harmful use of alcohol.
4. Reducing access to guns, knives, and pesticides.
5. Promoting gender equality to prevent violence against women.
6. Changing cultural and social norms that support violence.
7. Victim identification, care, and support programs.

Violence against Children

Physical and sexual violence against children has negative long-term and intergenerational sequelae. Although information on sexual violence against children is extremely limited, existing data indicate it might be widespread throughout the Americas. In population-based surveys in four countries, for
instance, women reported having experienced childhood sexual abuse (including forced sexual intercourse and other unwanted sex acts) before age 15 at rates that ranged from 2.6% in Paraguay to 2.9% in Ecuador, 4.0% in Nicaragua, and 5.8% in El Salvador. According to nationally representative surveys, 35% of women and 46% of men interviewed in Guatemala and 42% of women and 62% of men in El Salvador reported having been beaten during childhood (142).

The consequences of exposure to violence in childhood are wide-ranging and long-lasting and have an effect on children’s physical and mental health. Research has shown that prolonged stress and/or neglect can damage a child’s brain development, which can lead to impairments in his or her cognitive and emotional growth. Exposure to maltreatment also increases the risk that, as an adult, this child will be involved in risky behaviors such as smoking, alcohol use, high-risk sexual interactions, and unintended pregnancy. Finally, exposure to violence in childhood is also a major risk factor for becoming either a perpetrator or a victim of violence later in life; therefore, preventing child maltreatment is a necessary step for the prevention of multiple manifestations of violence in adulthood, including intimate partner and sexual violence against women (143, 144).

The co-occurrence of violence against children and against women is of particular importance and concern. Despite the paucity of studies on this subject, evidence suggests that these two forms of violence commonly occur simultaneously within the same household. Moreover, children who witness their mother’s abuse and who are themselves abused, may be affected differently or more severely than children who are exposed to only one form of violence (Box 3.12 examines the violence that women and children suffer in conflict areas and during disasters) (145, 146).

**Violence against Women**

The international public health community has increasingly recognized that violence against women, in addition to being a significant cause of injury and death, and a risk factor for serious physical and mental health problems among both women and their children, is a violation of women’s human rights (147, 148). When the term “gender-based” is used to qualify violence, it underscores that much of this violence is rooted in women’s subordinate social and economic status. Evidence indicates that women are most at risk of physical and sexual violence by those closest to them, particularly their intimate partners (149). Estimates of the prevalence of intimate partner violence, be it physical or sexual, from national, population-based studies in Latin America and the Caribbean range from 17% in the Dominican Republic to 53% in Bolivia (Figure 3.11). These estimates almost certainly reflect high levels of underreporting; subnational estimates put the figures even higher (150).

Data on sexual violence are often limited and difficult to compare; however, national estimates of the lifetime prevalence of forced sex after age 15 by any perpetrator, including partners, range from 10% to 27% of ever-partnered women aged 15–49 in Paraguay and Haiti, respectively. Significant proportions of women (aged 15–24) also report that their first sexual experience was forced, including 1.8% of women in Nicaragua. When asked, much higher proportions of women typically report that their first sexual experience was unwanted, even if they decline to call it forced; for example, in the 2008–2009 Reproductive Health Survey (RHS) in Jamaica, only 5% of young women said that their sexual debut was forced, but 44% said that it was unwanted.

The murder of women, termed femicide, has drawn greater attention in the Region, particularly in Mexico and Central America, where increasing numbers of femicides have been reported. Although reliable data and precise estimates of such violence are limited (Figure 3.12) (151, 152), evidence suggests that femicide is closely related to intimate partner violence and to organized crime.

Violence against women has serious negative consequences for women’s physical, sexual, reproductive, and mental health, ranging from immediate physical injury such as bruises, pain, and broken bones to sexual and reproductive health consequences, such as unwanted pregnancy and sexually
transmitted infections (STIs), and mental health consequences such as depression and suicidal ideation (147, 148).

National, population-based studies from eight countries in the Region found that, among women who experienced intimate partner violence, 41% of survivors in Honduras and 82% of survivors in Paraguay reported being physically injured as a result. The same comparative analysis documented that substantial proportions of women who had experienced partner violence in the Region reported wanting to die or kill themselves as a result of partner violence, including 24% of women interviewed in Colombia, 32% in El Salvador, and 39% in Guatemala. Data from the Region also show that one-half to more than two-thirds of women who experienced partner violence in the 12 months prior to the survey reported experiencing anxiety and depression so severe that they could not complete their work or obligations as a result.

Violence against women is also associated with unwanted pregnancy. In a comparative analysis of data from 12 Latin American and Caribbean countries, all surveys except Haiti’s showed that the proportion of women who reported an unplanned or unwanted pregnancy in the five years prior to the survey was significantly higher among those who reported physical or sexual intimate partner violence ever in their lifetime, compared with those who did not. In some surveys, these differences were larger.
than others. For example, the proportion of women who reported unwanted pregnancy in the five years prior to the survey was nearly twice as high among women who reported having experienced partner violence ever compared with those who did not in El Salvador (30.7% compared with 16.4%, respectively) and almost three times as high in Paraguay (17.6%, compared with 6.0%). Given that reproductive health services, particularly prenatal clinics, are the most widely used points of contact between women and the health system, it is imperative that reproductive health care providers be trained to appropriately identify cases of violence against women and care for survivors.

In terms of the direct and indirect costs of intimate partner violence, Inter-American Development Bank studies show that in 1996, domestic violence alone cost an equivalent of 2% of Chile's GDP and 1.6% of Nicaragua's. In considering the costs of violence against women, the impact that it has on children living in violent households, as well as its intergenerational consequences, must also be taken into account. In a comparative analysis of data from six countries in the Region, the proportion of women who reported physical or sexual intimate partner violence ever in their lifetime was significantly higher among those who reported having experienced physical violence during their childhood, compared with those who had not. In three surveys, in El Salvador and in Paraguay in 2008, and in Nicaragua in 2006/2007, the proportion of women who reported partner violence was more than twice as high among those who reported having experienced violence in childhood compared with those who did not. These findings underscore the importance of developing policies intended to prevent child maltreatment and eradicating the corporal punishment of children.

**Road Safety**

According to data published by the Pan American Health Organization (153), traffic accident injuries are the leading cause of death in the Americas among persons aged 5 to 14 years and the second leading cause in the group aged 15 to 44 years. The Region's adjusted mortality rate from traffic accident injuries is 15.82 per 100,000 population, although variations among the countries range from 4.3 to 21.8 per 100,000 population. Eleven countries have rates that exceed the regional average. An analysis of mortality trends shows major differences in the subregions. Thus, while these rates have declined significantly in North America's countries over the last 30 years, in South America only one country reduced them in the last 10 years and only two Caribbean countries report similar trends in more recent periods.

Statistics on traffic injuries and deaths are strongly associated with inequalities and inequities among the countries and within every country in the Region. Considering all deaths, 39% of persons who die from traffic injuries are vulnerable users (pedestrians, bicyclists, or motorcyclists), while 47% are motor vehicle occupants. An analysis by subregion yields even more differences. In the Andean and Southern Cone subregions, for example, the proportions of deaths of vulnerable users are 53% and 50%, respectively, while in North America the proportion is 23%. Regional average pedestrian mortality is 23%, with 43% for the Andean subregion and just 12% for North America. With regard to deaths of motor vehicle occupants, the North America subregion has the highest percentage (74%), while they represent only 20% in the Southern Cone. And these differences are not explained by level of car ownership. Proof of this is that North America has 70% of all vehicles in circulation in the Americas and 32% of all deaths, while the Southern Cone, with barely 17% of the regional fleet, registers 31% of deaths.

Among the factors that can contribute to these significant differences are institutional management and the legal framework. Most of the Region’s countries have institutional frameworks for regulating motor vehicle traffic to ensure road safety, but many lack the legal instruments and capacity to enforce them. Twenty-six of 32 countries have a regulatory agency devoted to coordinating road safety, but only 25% of them (Bahamas, Canada, Colombia, Costa Rica, Jamaica, Mexico, Nicaragua, and the United States) have an official,
government-adopted road safety strategy with national objectives and financing.

More than half of the Region’s countries (18) lack national policies that invest in public transportation and promote non-motorized transport, such as bicycles. All of North America’s countries have such policies, compared to just 11% of the countries in the English-speaking Caribbean. In addition, only eight countries report that they invest in road safety, with Costa Rica and the United States investing the most in road safety (US$ 7.38 and US$ 2.74 per person, respectively).

An analysis of legislation dealing with road accident risk factors shows that most of the Region’s countries have still not focused on law enforcement. Twenty have legislation in place dealing with risk factors (e.g., alcohol and speed) and with protective factors (e.g., the use of helmets, seat belts, and infant car seats). Disaggregated by risk factor, it can be seen that speed limits and seat-belt use are the measures most widely implemented in the Region. Mandatory motorcycle helmet use still needs work, however, such as the inclusion of all passengers and all types of thoroughfares in the measures. Data on control of alcohol consumption also show wide variations between countries and even within countries in terms of a blood alcohol concentration cutoff point of ≤ 0.05 g/dL. Finally, child car seat use also lags in the Region, even with regard to legislation that requires the use of car seats when young children ride as passengers.

REFERENCES


63. Spinoza PT, Arce EM, Faure MS, Terraza H, Daza D. Informe regional del Proyecto Evaluación Regional del Manejo de Residuos Sólidos Urbanos en ALC 2010 [Internet];


76. United States, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. SENSOR-Pesticides Database. Atlanta: CDC; 2011.

77. Mexico, National Center for Epidemiological Surveillance and Disease Control. Mexico, DF: CENAVECE; 2011.


101. Aguilar-Madrid G, Juárez-Pérez CA. El asbesto en México, 40 años de transferencia de riesgos, el inicio de una epidemia de


118. Banco Mundial. Panorama Regional de America Latina y el Caribe [Internet]; 2011. Available at: http://web.worldbank.org/WEBSITE/EXTERNAL/BANCOMUNDIAL/NEWSSPANISH/0,,contentMDK:


133. Brasil, Ministério da Saúde, Programa de Erradicação do Trabalho Infantil (Peti) [Internet]. Available at: http://www.mds.gov.


GLOSSARY

Bioaccumulation

Bioaccumulation is used to describe the increase in concentration of a substance in an organism over time. Such substances tend to be fat-soluble and are not easily broken by microorganisms.

Bioconcentration

Bioconcentration is the accumulation of a chemical in an organism’s tissues to higher levels than those in the surrounding environment.

Biomagnification

Biomagnification is a progressive accumulation of persistent substances in living organisms by successive trophic levels. It relates to the concentration ratio in a tissue of a predator organism as compared to that in its prey. Higher concentrations of persistent chemicals are found in higher levels of the food chain.

Climate change

The United Nations defines climate change as a “change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.”

Drinking water, improved sources

- Piped water into dwelling, also called a household connection, is defined as a water service pipe connected with in-house plumbing to one or more taps (e.g., in the kitchen and bathroom).
- Piped water to yard/plot, also called a yard connection, is defined as a piped water connection to a tap placed in the yard or plot outside the house.
- Public tap or standpipe is a public water point from which people can collect water. A standpipe is also known as a public fountain or public tap. Public standpipes can have one or more taps and are typically made of brickwork, masonry, or concrete.
- Tubewell or borehole is a deep hole that has been driven, bored, or drilled, with the purpose of reaching groundwater supplies. Boreholes/tubewells are constructed with casing, or pipes, which prevent the small diameter hole from caving in and protect the water source from infiltration by runoff water. Water is delivered from a tubewell or borehole through a pump, which may be powered by human, animal, wind, electric, diesel, or solar means. Boreholes/tubewells are usually protected by a platform around the well, which leads spilled water away from the borehole and prevents infiltration of runoff water at the well head.
- Protected dug well is a dug well that is protected from runoff water by a well lining or casing that is raised above ground level and a platform that diverts spilled water away from the well. A protected dug well is also covered, so that bird droppings and animals cannot fall into the well.
- Protected spring. The spring is typically protected from runoff, bird droppings, and animals by a “spring box,” which is constructed of brick, masonry, or concrete and is built around the spring so that water flows directly out of the box into a pipe or cistern, without being exposed to outside pollution.
- Rainwater refers to rain that is collected or harvested from surfaces (by roof or ground catchment) and stored in a container, tank, or cistern until used.

Drinking water, unimproved sources

- Unprotected spring. This is a spring that is subject to runoff, bird droppings, or the entry of animals. Unprotected springs typically do not have a “spring box.”
- Unprotected dug well. This is a dug well for which one of the following conditions is true: 1) the well is not protected from runoff water; or 2) the well is not protected from bird droppings and animals. If at least one of these conditions is true, the well is unprotected.
- Cart with small tank/drum. This refers to water sold by a provider who transports water into a community. The types of transportation used
include donkey carts, motorized vehicles, and other means.

- Tanker-truck. The water is trucked into a community and sold from the water truck.
- Surface water is water located above ground and includes rivers, dams, lakes, ponds, streams, canals, and irrigation channels.
- Bottled water is considered to be improved only when the household uses drinking water from an improved source for cooking and personal hygiene; where this information is not available, bottled water is classified on a case-by-case basis.

**Exclusive breastfeeding**

Exclusive breastfeeding means that the infant receives only breast milk. No other liquids or solids are given—not even water—with the exception of oral rehydration solution, or drops/syrups of vitamins, minerals, or medicines.

**Overweight and obesity**

Overweight and obesity are defined as abnormal or excessive fat accumulation that may impair health. Body mass index (BMI) is a simple index of weight-for-height that is commonly used to classify overweight and obesity in adults. It is defined as a person’s weight in kilograms divided by the square of his or her height in meters (kg/m$^2$). The WHO definition is that a BMI greater than or equal to 25 is overweight, and a BMI greater than or equal to 30 is obesity.

**Persistent organic pollutants (POPs)**

POPs are chemical substances that persist in the environment, bioaccumulate through the food web, and pose a risk of causing adverse effects to human health and the environment. This is a priority group of pollutants that consists of pesticides (such as DDT), industrial chemicals (such as polychlorinated biphenyls, or PCBs), and unintentional by-products of industrial processes (among them, dioxins and furans).

**Sanitation, improved**

- Flush toilet uses a cistern or holding tank for flushing water, and a water seal (which is a U-shaped pipe below the seat or squatting pan) that prevents the passage of flies and odors. A pour flush toilet uses a water seal, but unlike a flush toilet, a pour flush toilet uses water poured by hand for flushing (no cistern is used).
- Piped sewer system is a system of sewer pipes, also called sewerage, that is designed to collect human excreta (feces and urine) and wastewater and remove them from the household environment. Sewerage systems consist of facilities for collection, pumping, treating, and disposing of human excreta and wastewater.
- Septic tank is an excreta collection device consisting of a water-tight settling tank, which is normally located underground, away from the house or toilet. The treated effluent of a septic tank usually seeps into the ground through a leaching pit. It can also be discharged into a sewerage system.
- Flush/pour flush to pit latrine refers to a system that flushes excreta to a hole in the ground or leaching pit (protected, covered).
- Ventilated improved pit latrine (VIP) is a dry pit latrine ventilated by a pipe that extends above the latrine roof. The open end of the vent pipe is covered with gauze mesh or fly-proof netting and the inside of the superstructure is kept dark.
- Pit latrine with slab is a dry pit latrine that uses a hole in the ground to collect the excreta and a squatting slab or platform that is firmly supported on all sides, easy to clean, and raised above the surrounding ground level to prevent surface water from entering the pit. The platform has a squatting hole, or is fitted with a seat.
- Composting toilet is a dry toilet into which carbon-rich materials (vegetable wastes, straw, grass, sawdust, ash) are added to the excreta and special conditions maintained to produce inoffensive compost. A composting latrine may or may not have a urine separation device.
- Special case. A response of “flush/pour flush to unknown place/not sure/DK where” is taken to indicate that the household sanitation facility is improved, as respondents might not know if their toilet is connected to a sewer or septic tank.
Sanitation, unimproved

- Flush/pour flush to elsewhere refers to excreta being deposited in or nearby the household environment (not into a pit, septic tank, or sewer). Excreta may be flushed to the street, yard/plot, open sewer, a ditch, a drainage way, or other location.
- Pit latrine without slab uses a hole in the ground for excreta collection and does not have a squatting slab, platform, or seat. An open pit is a rudimentary hole.
- Bucket refers to the use of a bucket or other container for the retention of feces (and sometimes urine and anal cleaning material), which are periodically removed for treatment, disposal, or use as fertilizer.
- Hanging toilet or hanging latrine is a toilet built over the sea, a river, or other body of water, into which excreta drops directly.
- No facilities or bush or field includes defecation in the bush or a field or ditch; excreta deposited on the ground and covered with a layer of earth (cat method); excreta wrapped and thrown into garbage; and defecation into surface water (drainage channel, beach, river, stream, or sea).

Stunting

Stunting is a primary manifestation of malnutrition and is defined as length or height, for age that fall below the fifth percentile of the WHO Child Growth Standard, used as a reference.

Ultraviolet radiation (UV)

Ultraviolet radiation is part of the spectrum of electromagnetic radiation emitted by the sun. It is arbitrarily divided into three bands of different wavelength. Environmental and dermatological photobiologists commonly use divisions that are more closely associated with the biological effect of the different wavelengths, that is: UVA 320–400 nm, UVB 290–320 nm, and UVC 200–290 nm. The solar ultraviolet radiation of importance to human health consists of UVA and UVB; it is radiation in the UVB range that is absorbed by DNA, and that is the reason it is considered the most relevant for public health. Damage to DNA appears to be a key factor in the initiation of the carcinogenic process in skin.