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The Environmental Health of Latino Children

Olivia Carter-Pokras, PhD [Associate Professor],
Department of Epidemiology and Biostatistics, University of Maryland, College Park, Md.

Ruth E. Zambrana, PhD [Professor],
Department of Women's Studies, University of Maryland, College Park, Md.

Carolyn F. Poppell, ScM [Epidemiologist],
Department of Epidemiology and Preventive Medicine, University of Maryland School of Medicine, Baltimore, Md.

Laura A. Logie, MA [Doctoral Candidate], and
Department of Women's Studies, University of Maryland, College Park, Md.

Rafael Guerrero-Preston, DrPH, MPH [Post-Doctoral Research Fellow]
Department of Epidemiology, Mailman School of Public Health, Columbia University, New York, NY.

Abstract

Representing 1 in 6 children in the United States, Latino children incur disproportionate exposures to air pollutants, pesticides, and toxic industrial chemicals, as well as lead and mercury from candy, traditional folk remedies, religious practices, and other sources. Latino children also have higher rates of asthma, lead and mercury poisoning, behavioral and developmental disorders, and certain cancers. Concurrent exposure to multiple pollutants, pre-existing disease, poor nutrition, substandard housing, limited access to health care, and other factors related to their lower socioeconomic status increase Latino children's susceptibility to environmental contaminants. Targeted research, education, prevention and intervention efforts, and economic development initiatives are needed.

Latinos are now the largest minority group of children in the United States, representing more than 12 million, or 1 of every 6, children (U.S. Census Bureau, 2006). Nearly one third of all children living in poverty are Latino (Ramirez & de la Cruz, 2002). Latino children live in inner city areas and agricultural/rural communities, where they routinely are exposed to environmental contaminants. Children are particularly susceptible to the effects of exposure to environmental toxicants. Exposure to toxicants including pesticides, lead, mercury, polychlorinated biphenyls, and environmental tobacco smoke (ETS) may be related to the increases in recent decades in childhood asthma, cancer, and developmental disability (Perera et al., 2006).

Environmental exposures also are contributing to health disparities for Latino children. Latino children are disproportionately affected by asthma and the adverse health outcomes associated with pesticide exposure. Puerto Rican children have higher rates of asthma morbidity than any other racial or ethnic group (Carter-Pokras & Gergen, 1993). Compared with non-Hispanic White (NHW) children, Latino children have higher rates of lead (Bernard & McGeehin, 2003) and mercury poisoning (Schober et al., 2003); behavioral and developmental disorders (Flores & Zambrana, 2001); and leukemia (Ries et al., 2003), Hodgkin's lymphoma and germ

Federal data systems define the terms “Hispanic” or “Latino” as persons who trace their origin or descent to Mexico, Puerto Rico, Cuba, Central and South America, or other Spanish cultures. These terms are used interchangeably in this article.

cell tumors (Wilkinson et al., 2005). For example, Puerto Rican children have among the highest prevalence rates of chronic developmental conditions, functional limitations, and developmental problems. During 1992-1998, Hispanic children had the highest rates of acute lymphoblastic leukemia, the most common childhood cancer, of any racial or ethnic group (McNeil, Cote, Clegg, & Maurer, 2002). Although not all of these health outcomes for Latino children can be conclusively linked to environmental exposures, the weight of evidence raises serious public health concerns for this rapidly growing population.

The Institute of Medicine (1999) has concluded that minority and low-income communities are experiencing a form of "double jeopardy" with regard to environmental hazards. Not only do these communities incur disproportionate exposures to environmental contaminants, they also are more susceptible than the general population to the effects of such exposures because of limited understanding of environmental hazards, disenfranchisement from the political process, and socioeconomic factors such as poor nutrition, stress, and lack of adequate health care. In terms of nutrition, Latino children are more likely than non-Hispanic White (NHW) children to not have enough to eat (food sufficiency problem), to have iron deficiency, or to be over-weight (Zambrana, Carter-Pokras, Nunez, Valdez, & Villarruel, 2004). Latino children have disproportionately high rates of disease, limited access to health care, and often live in substandard housing and resource-poor communities (Zambrana & Logie, 2000). This article highlights what is known regarding environmental exposures and outcomes among Latino children and implications for reducing health disparities.

Latino children are disproportionately affected by asthma and the adverse health outcomes associated with pesticide exposure.

AMBIENT AIR POLLUTION AND ASTHMA

More than 90% of Hispanics in the United States live in metropolitan areas (U.S. Census Bureau, 2006). Hispanic children are three times more likely than NHW children to live in U.S. counties where air quality standards for criteria air pollutants are exceeded (31.4% vs. 10.6%), and nearly one third (31%) of Hispanic children live in counties where hazardous air pollutant concentrations exceed a 1 in 10,000 (10^{-5}) cancer risk level, compared with 12% of NHW children (U.S. Environmental Protection Agency [EPA], 2003).

Chronic exposure to air pollutants can have serious and lasting effects on children's health, including development and exacerbation of asthma, bronchitis, and other respiratory conditions; impairment of lung function; cardiovascular effects; neurobehavioral abnormalities; childhood cancer; and even death (Wigle, 2003). Factors such as pre-existing disease, lack of access to medical care, poor nutrition, socioeconomic factors, and concurrent exposures to other pollutants may contribute to increased susceptibility of Latino children and other urban minorities to the effects of air pollution (Hunninghake, Weiss, & Celedon, 2006).

Asthma prevalence among Latino individuals differs considerably depending on ethnic background, as well as geographic region, neighborhood characteristics, and residence housing (Ledogar, Penchaszadeh, Iglesias Garden, & Garden Acosta, 2000). Puerto Rican children have higher rates of asthma and more severe asthma than any other racial/ethnic group in the United States (Lara, Akinbami, Flores, & Morgenstern, 2006). A study of asthma in elementary school-aged children in East Harlem, New York, reported that 41% of Puerto Rican children had ever been diagnosed with asthma compared with 27% of other children in the survey (Findley et al., 2003). Current asthma prevalence was higher for Puerto Rican children (35.3%) than other children (21.5%). Latino children, particularly Puerto Rican children, also have more severe chronic asthma than do NHW children (Boudreaux, Emond, Clark, & Camargo, 2003). Moreover, hospital charges for asthmatic Latino children were found to be 21% higher than

for NHW children and the highest of any minority pediatric group (Gupta, Bewtra, Prosser, & Finkelstein, 2006).

Ethnic subgroup differences in the prevalence of asthma may be partly explained by the substantial heterogeneity that has been observed in the complex patterns of ancestry or ancestral admixture levels among Latinos (Gonzalez Burchard et al., 2005). An alternative explanation that may account for the observed differences in asthma morbidity among Latino subgroups is the impact that environmental stressors have on the epigenetic (heritable traits not dependent on the primary sequence of DNA) regulation of the immune system response in asthma (Berghe et al., 2006). Environmental stressors, such as indoor/outdoor allergens and pollution, adverse neighborhood characteristics, diet, and cultural beliefs and practices may have a differential impact in the epigenetic regulation of the cellular pathways that are known to interact in acute and chronic asthma events (Dolinoy, Weidman, & Jirtle, 2006).

A considerable body of evidence links increases in the levels of criteria pollutants to increased morbidity and use of health services among people with asthma (Delfino, Gong, Linn, Pellizzari, & Hu, 2003). Hazardous air pollutants from industrial sources and diesel truck and automobile traffic also may induce or exacerbate asthma among urban and inner-city children (Leikauf, 2002). Prenatal exposure to airborne polycyclic aromatic hydrocarbons (PAH), important components of diesel exhaust and other combustion sources, may increase respiratory symptoms and probable asthma by age 12 to 24 months (Miller, Garfinkel, & Horton, 2004). The disproportionate burden of psychosocial and environmental predictors for adverse respiratory health have spawned culturally targeted asthma interventions by community academic partnerships in predominantly Latino neighborhoods exposed to high levels of diesel exhaust particles (Tatis, Remache, & DiMango, 2005).

Indoor Allergens

Indoor allergen exposure is a risk factor for the initial onset of asthma and exacerbation of existing asthma (Bracken et al., 2002). Exposure to house dust mite allergen can cause asthma to develop in susceptible children, and exposure to cats, cockroaches, and house dust mites can exacerbate asthma. Living in homes with rats or mice also is strongly associated with asthma in children (Findley et al., 2003). Studies also have demonstrated the importance of the school as an environment where allergen exposure can lead to adverse respiratory effects such as asthma (Chew, Correa, & Perzanowski, 2005).

Environmental Tobacco Smoke

Children who live in a house with smokers have a 63% greater likelihood of developing asthma (Agency for Toxic Substances and Disease Registry, 2002a) than do children living in a house with only nonsmokers. An estimated 11% of Latino children younger than 6 years are exposed to tobacco smoke at home regularly (Centers for Disease Control and Prevention [CDC], 2003a). Young Latino children (2-4 years) have significantly greater exposure to ETS than older children (5-11 years), and this exposure is mainly from the mother's smoking (Preston, Ramos, Calderon & Sahai, 1997). Maternal smoking during pregnancy may be even more important to the development of asthma in young children than exposure to ETS after birth. Puerto Rican mothers are more likely to smoke during pregnancy (9.7%) than are Mexican American (2.4%) or Cuban women (3.0%) (Martin et al., 2002). This may explain in part the higher incidence of asthma found among Puerto Rican children. Smoking cessation appears to be the only reliably effective approach to preventing ETS exposure (Institute of Medicine, 2000).

ETS exposure by young children contributes to frequent respiratory infections, otitis media, bronchitis, and asthma (Klerman, 2004). Prenatal exposure to ETS and PAH among a cohort

of African Americans and Dominicans in New York also has been associated with a 7% reduction of birth weight and a 3% reduction of head circumference (Perera et al., 2004). These reductions have been shown to correlate with lower intelligence quotient, cognitive function and development, and school performance in childhood (Rauh et al., 2004).

PESTICIDE EXPOSURES

The widespread use of pesticides in the United States raises serious concerns for the health of Latino children who comprise a substantial segment of the population living and working in agricultural/rural and inner city areas where pesticide use is heaviest. Chronic pesticide exposure is associated with a wide range of adverse effects in children, including, but not limited to, neurologic and behavioral effects and endocrine disruption (Weiss, Amler, & Amler, 2004).

Agricultural Pesticide Exposures

Latinos account for 90% of all seasonal agricultural and migrant farm workers (Mehta et al., 2000). Migrant farm families are likely to have high pesticide exposures because of close proximity of housing to fields where spraying occurs, multiple family members working in the fields, poor quality of housing in which migrant families often live, and lack of adequate facilities to clean pesticide-contaminated work clothes (McCauley et al., 2001).

Children living with farm worker parents and those living in close proximity to agricultural farmlands have significant pesticide exposures (Curl et al., 2002). Mexican Americans as a group have disproportionately high exposures to several agricultural pesticides, including organophosphate pesticides, the organochlorine pesticide DDT, and the herbicide 2, 4-D (CDC, 2003b). There is, however, a continuing lack of information regarding pesticide exposures and pesticide-related illness among migrant farm workers and their children because of the transient nature of this population (McLaurin & Rettzlaff, 2000).

Pesticide Exposures in Urban Environments

Almost half of Latinos live in dense inner cities, where pesticides are extensively used for control of insects and rodents. Pesticide use in homes, high-density apartment buildings, schools, and day care centers places children at high risk of exposure, particularly poor children living in crowded, substandard housing where pest infestation is often a problem. A study of Dominican and African American women in New York found detectable levels of three insecticides during prenatal personal air monitoring: the organophosphates diazinon and chlorpyrifos, and the carbamate propoxur. Diazinon exposures for some women may have contributed to reduced infant birth weight and length (Whyatt et al., 2004).

LEAD AND MERCURY EXPOSURE

Lead poisoning remains a serious concern for children in the United States, disproportionately affecting racial and ethnic minorities and the poor (CDC, 2000). Exposure to deteriorating lead-based paint in homes is the most common source of lead exposure by children. For children younger than 6 years, the CDC has defined elevated blood lead levels (EBLLs) as greater than or equal to 10 micrograms per deciliter (μg/dL). However, concerns have been raised that blood lead concentrations well below 10 μg/dL can result in intellectual impairment (Canfield et al., 2003). Children with such low-level exposures often are asymptomatic, resulting in some cases being undiagnosed and untreated.

Puerto Rican and Mexican American children are more likely to have EBLLs than are NHW children because of their greater likelihood to live in older housing and inner cities (Carter-

Pokras, Pirkle, Chavez, & Gunter, 1990). Mexican American children also are more likely than the general population to use lead-containing folk remedies and lead-glazed pottery and to consume lead-contaminated candy and candy products from Mexico. Candy and candy products can be contaminated through packaging (e.g., tamarind candy in lead-glazed pottery; printed cellophane candy wrappers) and in the processing of ingredients such as chili powder (e.g., soil residue from fields, air-drying or storage where the chilies can accumulate dust from exhaust emissions, metal particles accumulated during the grinding process, and drying over open petrochemical fires). The Food and Drug Administration (2006) recently issued a draft guidance to significantly reduce the current guidance level for lead in food after testing of certain types of Mexican candy products showed evidence of lead contamination at levels above those presently allowed. The new guidance level that is proposed is 0.1 part per million (ppm) of lead, significantly lower than the current guidance level of 0.5 ppm.

Lead-based folk remedies used to treat empacho (a culturally bound or folk illness parents associate with intestinal or stomach obstruction) can cause serious morbidity and, on rare occasions, mortality. Multiple cases of severe lead toxicity have been reported following such exposures, with outcomes that include death and blood lead levels as high as 124 μg/dL (CDC, 2002).

Mercury

Mercury is highly toxic, particularly to the sensitive and rapidly developing central nervous system of the fetus, infant, and young child. Chronic exposure to mercury can lead to potentially irreversible neuropsychological deficits and emotional disturbances in children (National Research Council, 2000). The fetal brain is more susceptible than the adult brain to mercury-induced damage. Because of epidemiologic data on prenatal exposures accumulated during the past 15 years, the U.S. EPA reduced the allowable intake of methyl mercury from 0.5 to 0.1 μg of mercury per kilogram per day (Clarkson, Magos, & Myers, 2003).

Methyl mercury in fish and shellfish accounts for most of the mercury exposure by the general population (U.S. EPA, 2001). Subsistence fishing is a common practice among low-income groups, tribes, and indigenous people who rely on locally-caught fish for nutritional and economic needs (National Environmental Justice Advisory Council, 2002). Higher levels of total mercury were found in blood samples from Mexican American children (ages 1-5 years) and non-Hispanic Blacks than in NHW children examined during the 1999-2000 NHANES (Schober et al., 2003). Blood mercury levels were associated with fish consumption within 30 days prior to testing and increased with the number of fish meals consumed. A study of chemical exposures among predominantly Hispanic and African American subsistence anglers and their families found that both children and adults had unacceptably high exposures to mercury and numerous other toxic and persistent contaminants (Corburn, 2002).

Cultural and religious practices also contribute to mercury exposure among Latino children. Shops called botanicas or bodegas, located in Latino Caribbean communities, sell azogue, a magico-religious and ethnomedical remedy containing elemental mercury (U.S. EPA, 2002b). Mercury may be placed in a sealed pouch to be worn on a necklace or in a pocket, placed in open containers or candles, mixed with perfume, or sprinkled on the floor of dwellings or cars. Mercury also is used for the treatment of empacho, most often in infants. These uses of elemental mercury can result in both acute mercury poisoning and chronic low-level exposure by children (Riley, Newby, Leal-Almeraz, & Thomas, 2001).

BORDER HEALTH

Latino children living near the United States–Mexico border face substantial health threats from increasing levels of environmental contamination in the region. Air and water pollution,

improperly disposed hazardous wastes, shortages of potable water, and poor sanitation are longstanding public health problems for border communities. The water quality on the United States–Mexico border is affected by pollution generated from industrial zones, agricultural runoff, and wastes emitted by borderland boom towns. In the Rio Grande basin, most water is used for irrigation purposes, generating return flows with high levels of chlorides, phosphorus, and total dissolved solids (Li, Arnold, Kozel, & Forster-Cox, 2005). In recent years, industrialization and agricultural development have accelerated, resulting in more extensive environmental contamination by toxic industrial chemicals, air emissions from high-density traffic, and agricultural pesticides (Schmidt, 2000).

Few epidemiologic studies have focused on environmental health risks for Latino children in the region, but evidence exists that some local populations have elevated rates of certain cancers, systemic lupus erythematosus, asthma, lead poisoning, and neural tube defects. Population-based data from Texas show higher incidence of leukemia and acute nonlymphocyctic leukemia among Hispanics compared with NHW and African American children (Weiss et al., 1996). In the border town of Nogales, Arizona, the prevalence of systemic lupus erythematosus (103 cases per 100,000) has been reported to be two to seven times higher than the prevalence in the general U.S. population (Balluz et al., 2001), and the incidence of multiple myeloma from 1989 to 1993 was 2.4 times higher than expected rates. Several large-scale assembly and manufacturing plants called maquiladoras operate just across the border in Nogales, Mexico, and their hazardous waste releases are suspected of contributing to the unusually high disease rates of lupus and childhood and rare cancers in the area (Clay, 1999).

BOX. Sample questions for an environmental history

Issue: *The child's home, school, or day-care center might expose him or her to potential toxicants.*

- Do you live in an apartment, house, or mobile home?
- What are the age and condition of your home?
- How is your home heated? Do you have a fireplace or a wood stove?
- Do you use pesticides inside or outside your home (including use on children and pets)?
- Is your home (day care center, etc.) near a polluted body of water, industrial plant, commercial business, or dump site?

Issue: *Family members' jobs might involve exposure to contaminants.*

- What is your occupation? What is your spouse's occupation? Do other members of the family have jobs? If so, what are they?

Issue: *The child might be exposed to tobacco smoke.*

- Do you, your spouse, other family members, babysitter, or visitors smoke in your home? In your car?

Issue: *The child might eat food contaminated with environmental toxicants.*

- For breastfeeding mothers: Have you tested your water supply for lead?
- If you are not breastfeeding and you make the baby's formula with tap water, what procedure do you follow? Do you ever use hot tap water to make the formula?
- Do you wash fruits and vegetables before giving them to your child?

Issue: *The child might be at high risk for lead poisoning*.

- Is there a brother, sister, housemate, or playmate being followed or treated for lead poisoning (i.e., blood lead 15 μg/dL)?
- Does the child live near an industry likely to release lead?
- Do you use pottery from another country?
- Do you or your child eat candy or candy products from Mexico?

Issue: *The child might be at high risk for mercury poisoning*.

- Do you use home remedies or medicines from another country?
- Do you buy medical or religious products at botanicas or bodegas?

Issue: *Discerning whether an illness is related to the environment*.

- Do symptoms subside or worsen in a particular location (e.g., home, child care, school, or room)?
- Do symptoms subside or worsen on weekdays or weekends? At a particular time of day?
- Are other children whom your child spends time with experiencing symptoms similar to your child's?

Modified from the Agency for Toxic Substances and Disease Registry's 2002 adaptation of screening (1996) and Etzel and Balk (1999).

IMPLICATIONS FOR HEALTH CARE PROVIDERS

Children's health care providers need to be able to elicit a complete environmental health history and plan appropriate environmental and therapeutic interventions. An environmental health questionnaire should be part of routine pediatric health maintenance visits (Dunn, Burns, & Sattler, 2003). Additional questions regarding traditional practices, ingestion of candy imported from Mexico, and purchases of medico-religious products should be added as part of a culturally responsive environmental health history. The Box provides sample questions that can be used to take an environmental history. In caring for Latino children, health care providers must be knowledgeable about the potential for increased environmental exposures, including certain religious and dietary practices, and their associated clinical risks in this population.

Health care providers should be aware of successful health education and behavior modification interventions such as asthma management education paired with coaching for ETS exposure reduction (Hovell et al., 2002) and educational interventions to reduce cockroach allergen exposures (McConnell et al., 2005). Although the culturally targeted intervention program for Latinos in New York City by Tatis et al. (2005) resulted in a significant reduction in emergency department visits and hospitalizations over a 1-year period, only 11.6% of those eligible participated. Key elements of the program were hiring and training residents from within the community as asthma educators and developing and testing culturally targeted educational materials in collaboration with local community-based organizations.

The effectiveness of asthma interventions can be enhanced through health care system interventions that recruit and retain staff that reflect the cultural diversity of the community, use interpreter services or bilingual providers, provide cultural competency training for health care providers, use linguistically and culturally appropriate health education materials, and are

located in culturally specific health care settings (Anderson, Scrimshaw, Fullilove, Fielding & Normand, 2003).

Latino children are at greater risk of morbidity and premature death from such conditions as asthma, lead and mercury poisoning, behavioral and developmental problems, and certain cancers.

CONCLUSIONS

Elimination of preventable environmental health disparities should be a societal priority and of particular concern to pediatric health care professionals, legislators, child health advocates, and parents. One of the overarching goals of the Healthy People 2010 initiative is elimination of all health disparities, and guidelines for management of asthma have been incorporated into Healthy People 2010 objectives (U.S. Department of Health and Human Services, 2000). With high rates of poverty and greater likelihood of living in public, rental housing, or multifamily units, Latino families with asthmatic children may struggle to implement recommended interventions because of insufficient guidance, lack of funds, competing priorities, or lack of control over their indoor environment that would be desirable to modify (e.g., carpeting, excessive moisture, and comprehensive pest management).

Available evidence strongly suggests that Latino children not only incur disproportionate exposures to environmental toxicants but also are more susceptible than the general population to the effects of such exposures. Physiologic and behavioral factors that place all children at risk from environmental exposures are compounded for Latino children by social, economic, cultural, and political factors. As a result, Latino children are at greater risk of morbidity and premature death from such conditions as asthma, lead and mercury poisoning, behavioral and developmental problems, and certain cancers.

Efforts to address environmental health disparities for Latino children have been sparse and fragmented. Identifying and mitigating the causes of these disparities requires a multi-faceted, multidisciplinary, and integrated approach; coordination of federal, state, and local public health efforts; implementation of preventive measures; and educational efforts to improve community and health care provider understanding of environmental hazards (Lee, 2002). For Latino children, elimination of environmental health disparities will require substantial new investments in, and commitment to, environmental health education, prevention and intervention programs, and targeted public health research.

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