Maryland's Children and the Environment

August 2008

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STATE OF MARYLAND

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DHMH MDE

MDE

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This report, *Maryland's Children and the Environment*, is the first state-wide assessment of children's environmental health. We intend it to be the beginning of a regular effort to catalog and present data on children's environmental health that can be used by the public and policy makers to set priorities and measure progress. Children's health and the creation of environmental conditions that will assure that health in the future are the highest priorities of our departments.

This report is possible because of the close collaboration between the Departments of Health and Mental Hygiene and the Environment. That collaboration, which involves data sharing, coordination with local health departments on common problems, and the creation of joint projects like this, helps to assure an effective response to the complex environmental health challenges confronting the State. We are also grateful for the cooperation and contributions of the Departments of Agriculture and Education, the Maryland Poison Center at the University of Maryland, and the many individuals who were instrumental in producing this report.

Maryland's environmental health challenges will only be solved by the cooperative efforts of the public, government, business, and the academic sector. The first step is to understand where we are and create ways to measure our progress. We urge you to read this report and to use these indicators in our collective and individual efforts to promote a healthier environment for our children.

John M. Colmers
Secretary

Shari T. Wilson
Secretary

Foreword

It is well-recognized that the health of children is directly related to the environment generally and to specific environmental factors. Maryland is fortunate to have a strong infrastructure of public, private, and academic institutions and individuals committed to the health of children and the promotion of healthy environments. Perhaps no single factor is more important to these efforts than reliable, accurate information that enhances the public understanding and supports the development of effective prevention efforts.

Maryland's Children and the Environment is intended to serve this need for information. It highlights specific data and indicators, informs us of their quality, and will help us work together to improve children's health through the adoption of beneficial environmental policies.

— *The Project Committee*

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  Public Water Supply Program
  Lead Poisoning Prevention Program
  Land Restoration Program
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Executive Summary

This report describes the relationship between the health of Maryland's children and environmental factors that can affect their health. It is the state's first effort to synthesize from many available data sources a coherent picture of Maryland's children and the environment. In so doing, the emphasis of the report is not to answer definitively whether and how much of any disease is related to environmental factors. Rather, it is an attempt to provide the public, policy makers, researchers, and public health officials with measures that can be used to gauge Maryland's progress in improving the environment and reducing the rates of environmentally-related health conditions in children.

The proposed indicators in this report are neither perfect nor final. In some cases there may not be enough reliable, valid data to use the indicators. In some cases it may not be technologically or economically feasible to obtain the data. In other cases, there are social and legal constraints to the acquisition of data. However, given the current level of technology and state of surveillance within the state, these indicators appear to be a good starting point for discussion.

Findings

There is evidence of improving conditions for some of the environmental hazards described in this report. The improvements are most notable for hazards that have been the focus of concerted government attention, such as outdoor air pollutants, water pollutants, and childhood exposure to lead.

- ***Outdoor Air Pollutants.*** The outdoor air pollutant indicators reveal a picture of improving air quality for some air pollutants and continued need for improvement for others. Results must be estimated for areas outside the reach of the monitoring network.
- ***Drinking Water Contaminants.*** Public water systems in Maryland and the U.S. report similar rates of health-based violations. The percentage of children living in areas served by community water systems with violations of drinking water monitoring and reporting requirements is slightly lower in Maryland than in the U.S. as a whole. There is a significant data gap for private domestic wells, for which there is no routine water quality testing.
- ***Lead in Children.*** The percentage of children with blood lead levels above Centers for Disease Control's recommended action level has declined steadily. Blood lead levels in children and the stock of pre-1950 housing (the greatest source of lead exposure) continue to decline. There are, however, still geographic and racial disparities in blood lead levels.

Similar gains are not as evident in hazards more likely to be related to personal behavior (such as smoking during pregnancy) or that are more difficult to regulate (such as indoor environmental hazards):

- ***Indoor Pollutants.*** There is no routine monitoring for indoor pollutants. Indirect measures are currently the only metric we have to determine the impact of indoor pollutants. Such measures include the reported percentage of homes with children less than five years of age where someone smokes regularly, to determine exposure to environmental tobacco smoke, and the proportion of housing stock built before 1950, to indicate potential exposure to lead-based paint. Overall, the limited available data suggests progress is still needed in reducing indoor air pollutants. Better measures of indoor hazards are clearly needed, including measures in non-home environments (e.g., schools, daycare facilities).

One of the report's most striking findings is how much is not known or routinely measured regarding actual levels of contaminants in children's bodies. With the exception of blood lead tests in older communities, there is no systematic monitoring of blood, urine or other tissues for chemical exposures in children. Examples of biomonitoring gaps include:

- ***Pesticide-related exposures and illnesses.*** There are currently no data regarding actual pesticide levels in children, including the levels of long-lived pesticides. This makes it difficult to estimate the potential impact of low-level pesticide exposure on children's health. Reports of pesticide-related illnesses usually concern acute poisonings. Better biomonitoring and surveillance could lead to more targeted prevention efforts, especially where racial/ethnic discrepancies are evident.
- ***Exposures to contaminants in fish.*** Polychlorinated biphenyls (PCBs) or mercury are found in recreational fish throughout the state. The Maryland Department of the Environment monitors recreational fish and issues fish consumption guidelines. Contaminants are also present in commercial fish and are monitored by the U.S. Food and Drug Administration. Monitoring of PCB and mercury levels in pregnant women and children would augment our understanding of the true extent of these exposures and their potential significance.

Finally, while there is some surveillance for diseases that may be related in part to environmental hazards (for example, asthma or childhood cancers), the absence of systematic exposure data (including biological monitoring data) makes it very difficult to determine how much of the disease might be related to preventable environmental exposures. Examples include:

- ***Childhood Asthma.*** There is no robust measure of the burden of illness due to asthma. According to annual phone surveys, approximately 13 percent of Maryland children have asthma. Rates of diagnosis, emergency department visits, and hospitalizations for asthma vary by race and geographic location. It is not possible to state what portion of the asthma prevalence or severity is related to specific environmental exposures, although these factors are known to contribute.
- ***Childhood Cancer.*** Overall rates of childhood cancer incidence and mortality have improved over time. Most children diagnosed with cancer survive. There are discrepancies by race and geographic location for cancer overall, but only limited data on what contribution environmental exposures play. Specific childhood cancers could be more significantly affected by environmental exposures, but the available data make it difficult to address this question.
- ***Neurodevelopmental Disorders.*** Counts of children in certain categories of special education were used to estimate the burden of neurodevelopmental disorders in the childhood population. The overall rate of these disorders was relatively consistent from 2001 to 2004. Given the available data, it is not possible to estimate what contribution, if any, environmental factors specific to Maryland may play in these disorders.

Challenges and Opportunities

Not only are there gaps in Maryland's data, there are also significant gaps in our knowledge base and methods for tracking health and environmental conditions. Two emerging trends are significantly altering the kinds of data needed to assess children's environmental health: first, the significant advances in our understanding of biological mechanisms of disease, particularly at the molecular level; and second, an increased appreciation for the interactions among health, environment, and social and neighborhood factors that influence health. The list below, while not exhaustive, illustrates the kinds of data that might prove useful to researchers and public health efforts in the near future:

- ***Endocrine disruptors.*** These are compounds that have been shown to affect endocrine function, and are also present in the environment.
- ***Pharmaceuticals and personal care products.*** These compounds, used widely in agriculture and commerce, are being identified in environmental media (particularly water) and there is concern about their effects on both ecosystems and human health.
- ***The built environment.*** There is increasing interest in the extent to which the built environment can both enhance and impair public health, particularly for children. For example, the extent to which neighborhood design promotes or discourages physical activity is being investigated as a contributing factor in childhood obesity.
- ***Effects of environment on perinatal outcome.*** Perinatal conditions refer to those that occur during the period around childbirth, especially the five months before and one month after birth. There is research that suggests links between many environmental contaminants and a broad range of poor perinatal outcomes, including fetal and infant death, preterm birth, low birthweight, and birth defects.

In addition to gaps in science, there are continuing challenges in the mechanics of surveillance, that is, in collecting, sharing, and using data. While new technologies are making it easier to conduct surveillance, there is a need to address the legal and administrative surveillance infrastructure at the same time.

Health Disparities and Environmental Justice

One issue that weaves throughout this report and applies to all of the indicators is that of health disparities and environmental justice. This concept—that certain groups, based on race, class, or other characteristics, have assumed or are assuming a disproportionate share of the burden of environmental contamination or effects—has been the topic of research, as well as private and public efforts to document and correct historical inequities. In this report we have attempted to use indicator data to demonstrate how exposure and disease burdens are distributed, but in many cases the data to do so are limited or unavailable. Maryland has established several mechanisms to address these issues, including the Office of Minority Health and Health Disparities within the Department of Health and Mental Hygiene, and the Maryland Commission on Environmental Justice and Sustainable Communities.

Conclusion

Maryland has made significant progress in reducing children's exposures to some environmental hazards. However, there are limitations in the state's capacity to conduct surveillance on important and emerging environmental hazards and exposures, as well as health outcomes. Maryland's investments in monitoring and surveillance have taken us part of the way in understanding children's environmental health in the state. We are aware of important trends and important differences by region and population group. It is important for public health policy to be guided by the best available science, supported by effective surveillance and dialogue. We hope that the indicators presented in this document advance the public dialogue and lead to improvements in children's environmental health.

Introduction, Methods, and Data Sources

Maryland's Children and the Environment builds on a popular national report by the U.S. Environmental Protection Agency (EPA), entitled *America's Children and the Environment* or ACE (EPA, 2003). The Maryland report, like its national model, presents indicators for use by the public, policy makers, and others to understand and track environmental influences on children's health.

The structure of the report and the selection of indicators reflect our current understanding of the relationship between environment and health. Part 1: Environmental Contaminants, summarizes our current understanding and measurement of chemical and physical hazards in the environment that have been implicated in children's health effects. Part 2: Body Burden, describes the limited information available on contaminants measured directly in children. Finally, Part 3: Childhood Illnesses, describes the data available on illnesses and health effects that are thought to be affected by environmental exposures. For each indicator, the report provides current and historical information about the indicator, a summary of recent trends for the indicator, and (where available) comparisons with national data or goals.

The relationship between environmental exposures and children's health is rarely straightforward. First, the relationship must be viewed in the context of the overall health of children, which is influenced by many factors such as income, access to health care, societal stressors, and education (see Appendix A: An Overview of Maryland's Children).

Second, there are relatively few instances (for example, lead) where there is good understanding of the biological mechanisms of injury and the quantitative relationships between exposure and health outcomes. Health outcomes are very often influenced by a combination of behavioral, social, genetic, and environmental factors. Thus it is difficult to state with confidence how much the current health status of Maryland's children is determined by any single environmental factor or exposure, and even more challenging to predict how a change in a specific environmental exposure will affect future health status. However, the overall weight of evidence suggests strongly that a reduction of exposure to the environmental hazards enumerated in this report will have positive benefits for the health of Maryland's children.

The indicators of children's environmental health in this report represent a broad cross-section of environmental and health quality measures routinely collected in Maryland and other states. Some are collected as part of routine health surveillance programs. Many are collected as part of mandated environmental regulatory programs. In a few cases, the indicators were derived from data that are not primarily collected for surveillance purposes.

The health indicators in this report are derived from data collected by public health surveillance programs in the Maryland Department of Health and Mental Hygiene (DHMH):

- ***Vital Statistics.*** The registry of births, deaths, and fetal deaths in Maryland, and the analysis of population data for Maryland.
- ***Cancer Registry.*** The system that collects cancer data from hospitals, clinics, and treatment centers all over the state, analyzes the data, and issues reports on rates of new cancer cases.
- ***Behavioral Risk Factor Surveillance System (BRFSS).*** A periodic telephone surveillance program of approximately 8,900 Maryland households that collects data on behaviors and conditions that place Marylanders at risk for chronic disease, injury, and preventable infectious diseases.

Why are children of special interest?

The amount and frequency of exposure explains some but not all of the risk associated with exposure to an environmental contaminant. Other factors come into play to influence whether a given type of exposure has a low or high potential to cause illness. One's life stage is important, as are genetic makeup and pre-existing health conditions.

For various reasons, children can be more sensitive or have higher exposure to contaminants than adults. The two main reasons are differences in their physiology and behavior.

- *Physiology.* Children take in and process environmental contaminants/pollutants differently from adults. For example, their breathing rate and ratio of skin surface to body mass are greater than adults and their skin and lungs can be more permeable to toxicants. Children drink more water and other liquids for their body weight than adults. Children's brains are not fully developed, are a larger proportion of their body mass, and have greater circulation than adults. In addition, the blood-brain barrier is not fully formed in young children. These conditions tend to make children more sensitive to neurotoxicants. Their organ systems are still developing through puberty, and are sometimes more sensitive to environmental exposures than adult organs. Chemical contaminants may affect the division, growth, maturation and differentiation of children's cells. Rapidly dividing cells are more sensitive to these disruptions.
- *Exposure.* Children have very different behaviors that may lead to more environmental exposures than adults. Children's behavior of playing on the ground or floor and mouthing objects can all result in higher exposures. The lower breathing zone can expose children to air-borne contaminants that sink towards the ground. Their diets may be very different from adults. Moreover, children may unknowingly engage in risky behaviors. Children may also be exposed to different environments than adults. On average they spend more of their time outdoors.

- ***Pregnancy Risk Assessment Monitoring System (PRAMS).*** A survey of mothers regarding pregnancy outcomes and preconception, prenatal, and post-neonatal behaviors associated with birth outcomes.

The one body burden indicator, blood lead in children, is monitored through the Childhood Lead Registry (CLR) at Maryland Department of the Environment. The registry gathers laboratory results for all children 0 – 18 years of age, and provides the results to local health departments as needed for case management and planning.

The environmental quality indicators come from monitoring programs in the Maryland Department of the Environment (MDE) and the U.S. Environmental Protection Agency:

- ***Ambient Air Quality Monitoring.*** Currently, twenty-four air monitoring sites around the state measure ground-level concentrations of major pollutants, meteorology, and other research-oriented measurements. The concentrations of so-called toxic air pollutants are estimated through modeling by EPA.
- ***Water Quality Monitoring.*** Monitoring of drinking water depends on the source, size, and rate of use of drinking water supplies. Public water supplies are required to do regular testing for contaminants and report the results to the Maryland Department of the Environment.
- ***Fish Tissue Monitoring.*** Recreational fish are sampled for contaminants on a rotating basis around the state and used to develop fish consumption guidelines.

Indicators were selected based on the significance of the outcomes, availability of data, and opportunities for intervention. Significant outcomes were considered those that affected larger numbers of children, led to more serious health consequences, or had special relevance due to disparate impacts in different population groups. Indicators were considered more useful

Table 1. Children's Environmental Health Indicators for Maryland

Topic **Indicator** **Page**

if based on data that permitted analysis by temporal, geographic, and demographic variables of interest, and comparisons with national data or previously developed benchmarks. Indicators were also favored if they were readily linked to interventions, such as policy recommendations, education, or other efforts. In some cases, potential indicators were excluded because of the lack of data. In other cases, indicators were included because of their potential public health significance, even though at the current time the data systems required to fully describe these conditions were incomplete.

A list of the indicators in this report is shown in Table 1. They include indicators of environmental contaminants (twelve indicators), indicators of human exposures to contaminants (body burden, two indicators), and indicators of health outcomes known or suspected to be related to environmental exposures (five indicators).

Throughout this report, the ***Healthy People 2010*** national prevention goals are referenced (DHMH, 2001). More information about Healthy People 2010 can be found at www.healthypeople.gov.

Part 1: Environmental Contaminants

This section describes selected environmental contaminants in children's indoor and outdoor environments, including air, drinking water, and contaminants in soil and food.

1.1 Outdoor Air Pollutants

Outdoor air pollution is a complex mixture of gases and small particles of both natural and human origin. Its composition can vary significantly from one time or place to another. For regulatory purposes, there are two main categories of air pollutants: criteria air pollutants and air toxics.

Criteria Air Pollutants

Criteria air pollutants are those regulated under EPA's Clean Air Act: ozone, lead, carbon monoxide, sulfur dioxide, oxides of nitrogen, and both fine and coarse particulate matter (PM). The standards for these pollutants are updated every few years by the EPA under the Clean Air Act, and are set at levels designed to protect public health with an adequate margin of safety.

- ***Ozone.*** Ground-level ozone, the major component of smog, is formed when emissions of volatile organic compounds (VOCs) and nitrogen oxides (NO_x) combine in the presence of heat and sunlight. The VOCs and NO_x are emitted from many sources, including motor vehicle exhaust, industrial emissions, gasoline vapors, chemical solvents, and naturally occurring sources. Sunlight and hot weather work together to accelerate the chemical reactions and form harmful levels in the air, making ozone in Maryland primarily a summertime pollutant.

  Children, older adults, and people with lung disease can be affected by lower levels of ozone than healthy adults. Ground-level ozone can trigger symptoms, including chest pain, coughing, throat irritation, and congestion, and worsen bronchitis, emphysema, and asthma. Studies suggest that exposure over a long period of time can reduce lung function, cause additional cases of asthma in children who exercise outdoors, and increase asthma symptoms overall (AAP, 2004).

- ***Particulate Matter.*** Particulate matter consists of very small solids and liquid droplets suspended in the air. Particles that have a diameter of 10 micrometers or less are referred to as PM_{10} or "coarse" particles. Particles with a diameter of 2.5 micrometers or less are called $PM_{2.5}$ or "fine" particles. Fine particles are small particles or liquid droplets that usually consist of acids, organic chemicals, or metals from combustion sources such as cars, trucks, and other engines, coal-fired power plants, and wood smoke. A significant portion can also form from chemical reactions in the air. Coarse particles tend to consist of larger, wind-blown soil or dust particles and allergens, such as fragments of pollen or mold spores.

  Particle pollution, especially fine particles, can get deep into the lungs. Studies have linked them to a variety of problems, including irritation of the airways, decreased lung function, aggravated asthma, development of chronic bronchitis, irregular heartbeat, nonfatal heart attacks, and premature death in people with heart or lung disease. People with heart or lung diseases, children and older adults are the most likely to be affected. However, even healthy individuals may experience temporary symptoms if the levels are high enough.

The Maryland Department of the Environment maintains approximately twenty fixed monitors for criteria air pollutants, with the majority in the central, more heavily populated part of the state. This represents one of the more dense monitoring networks in the eastern

U.S. due to the cluster of large metropolitan areas in the state, despite Maryland's relatively small size (MDE, 2007). Results must be estimated for areas outside the reach of the monitoring network. Ozone behaves as a regional pollutant, meaning that county-wide estimates are generally accurate. Levels of PM are more strongly influenced by local conditions, meaning there is more uncertainty in county-wide estimates.

Air Toxics

In addition to criteria air pollutants, there is another, larger group of 188 chemicals called air toxics (also called hazardous air pollutants) that are regulated under the Clean Air Act. Examples include benzene, trichloroethylene, mercury, and chromium. Air toxics have many sources in the environment. Their potential health effects are also diverse, ranging from cancer to asthma and respiratory problems, neurological problems such as learning disabilities, and other effects.

Specific numerical air quality standards do not exist for these compounds, but they are nonetheless regulated to achieve reductions in exposures with the goal of improved public health. The major regulated sources of air toxics include:

- ***Major point sources.*** Large industrial facilities such as chemical manufacturing plants, refineries, and waste incinerators.
- ***Area sources.*** Small stationary facilities such as dry cleaners and gas stations. Although emissions from individual area sources are relatively small, collectively their emissions can be of concern.
- ***Mobile sources.*** Cars, trucks, buses, farm and construction equipment, lawn and garden equipment, marine engines, aircraft, and trains.

Indicator E1: Trends in Average Daily Peak Ozone Concentrations

Several measures indicate that ozone pollution in Maryland has decreased in recent years. There are fewer days with high ozone, lower maximum concentrations, shorter ozone episodes, smaller areas where ozone is above the standard, and a change in the state's designation from "severe non-attainment" to "moderate non-attainment" for ozone. Since 2002, an average of 2.5 weeks per year have experienced eight-hour ozone concentrations greater than or equal to 85 parts per billion (ppb) in contrast to the two months worth of exceedance days which existed in the 1980s (MDE, 2007). The sources of ozone are under better control through rules controlling the use and handling of volatile chemicals (40 percent reduction since 1990) and through controls and inspections on cars and other vehicles (50 percent reduction in vehicle emissions since 1990). Controls on the regional emissions of NO_X since 2003 have had a notable impact on ozone levels.

Additional reductions in ozone will continue as new rules scheduled for power plants take effect in Maryland and upwind states. In 2008, EPA tightened the ozone standard to 75 ppb to better protect public health as recommended by newer health studies. This change is expected to trigger additional controls.

Figure 1 shows how ozone levels have changed in Maryland since the early 1990s. The curves represent an average of all eight-hour peak ozone values in Maryland grouped by four-year periods.

- Peak summertime ozone concentrations are declining in Maryland. The greatest drop occurred in the most recent period, from 2003 to 2006.
- Similar trends have occurred throughout the Mid-Atlantic states (not shown).

Healthy People 2010: Objective 8-01 of Healthy People 2010 aims to reduce the proportion of persons exposed to air that exceeds the levels of U.S. EPA's health-based standards for harmful air pollutants.

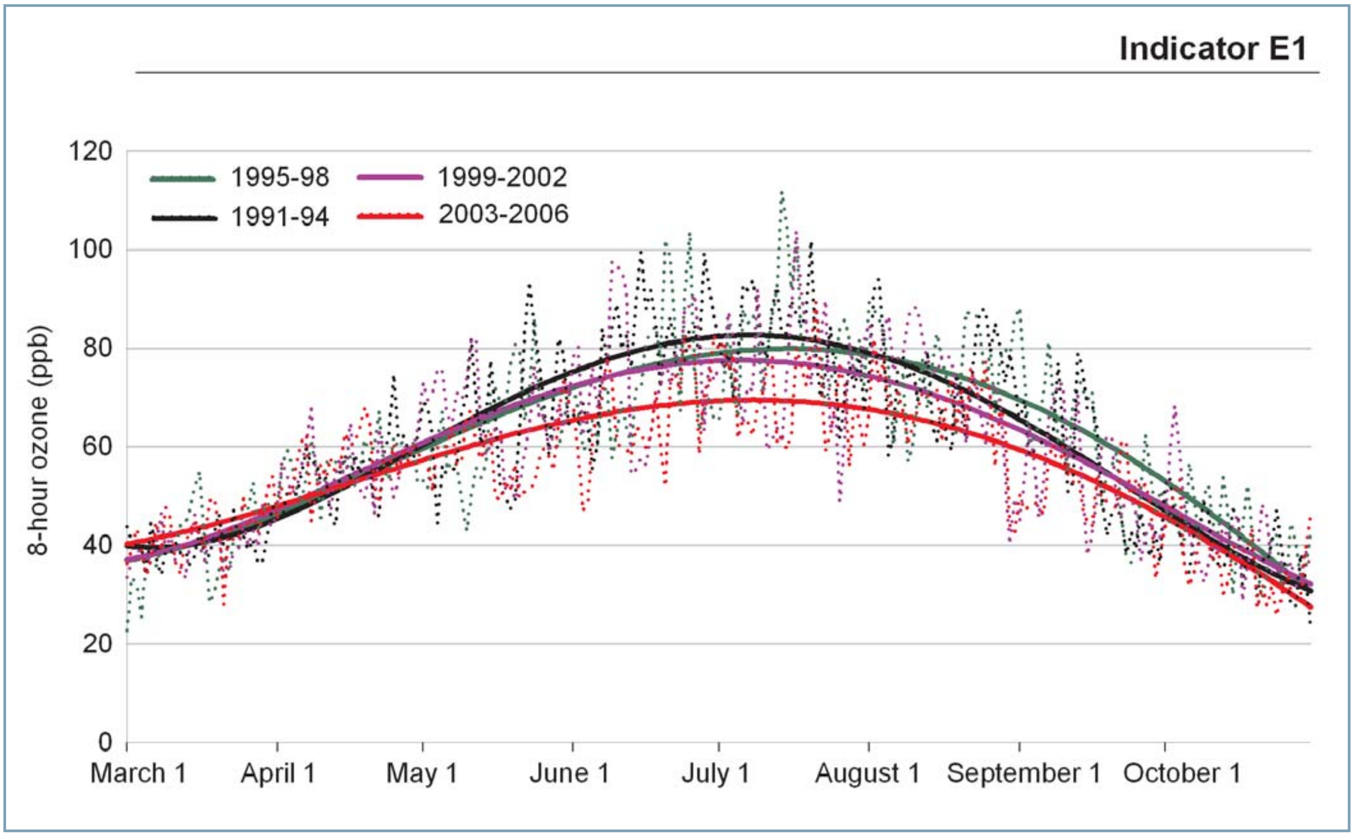

Figure 1. Average Ozone Concentration in Maryland
Source: Maryland Department of the Enrivonment

Indicator E2: Distribution of Annual Ozone Concentrations

Harmful levels of ozone occur in both urban and rural areas from a combination of local sources and winds that can carry pollution hundreds of miles. Maryland has significant problems with pollution transported from other states. On the worst ozone days, over 50 percent of the air pollution in Maryland originates in other states, primarily from emissions generated by power plants in the Midwest (MDE, 2004; MDE, 2005). As a result of control measures, there has been a sustained decline in ozone precursor levels (particularly nitrogen oxides) throughout the eastern U.S. The maps in Figure 2 show where ozone levels were above the national standard over the past decade. While short-term ozone peaks are not represented, the maps do indicate where short-term peaks are most likely to have occurred. As with all interpolation techniques, there are inevitably areas of over or under estimation.

- Areas of ozone above the national standard (85 ppb) are smaller than a decade ago.
- Ozone levels are highest in suburban and rural areas as a result of upwind sources, heat and other weather conditions, the daily timing of ozone formation in the atmosphere, and the influence of other chemicals that scavenge ozone from the air.

Healthy People 2010: Objective 8-01 of Healthy People 2010 aims to reduce the proportion of persons exposed to air that exceeds the levels of U.S. EPA's health-based standards for harmful air pollutants.

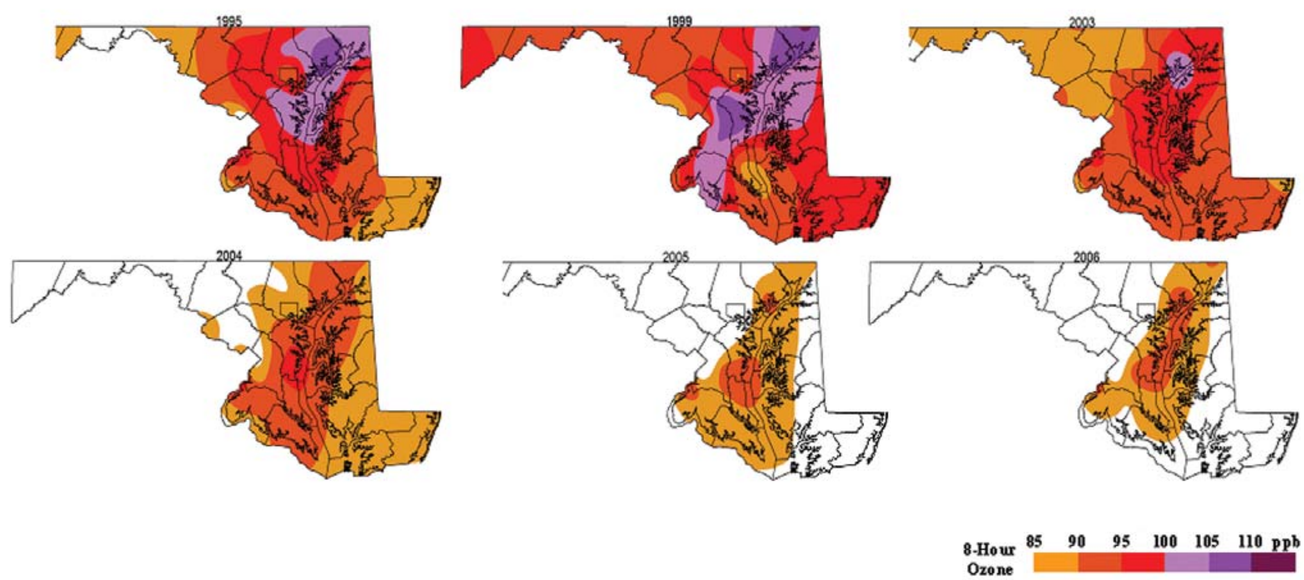

Figure 2. Distribution of Ozone Concentration >85 ppb in Maryland, 1995 – 2006.
Source: Maryland Department of the Enrivonment

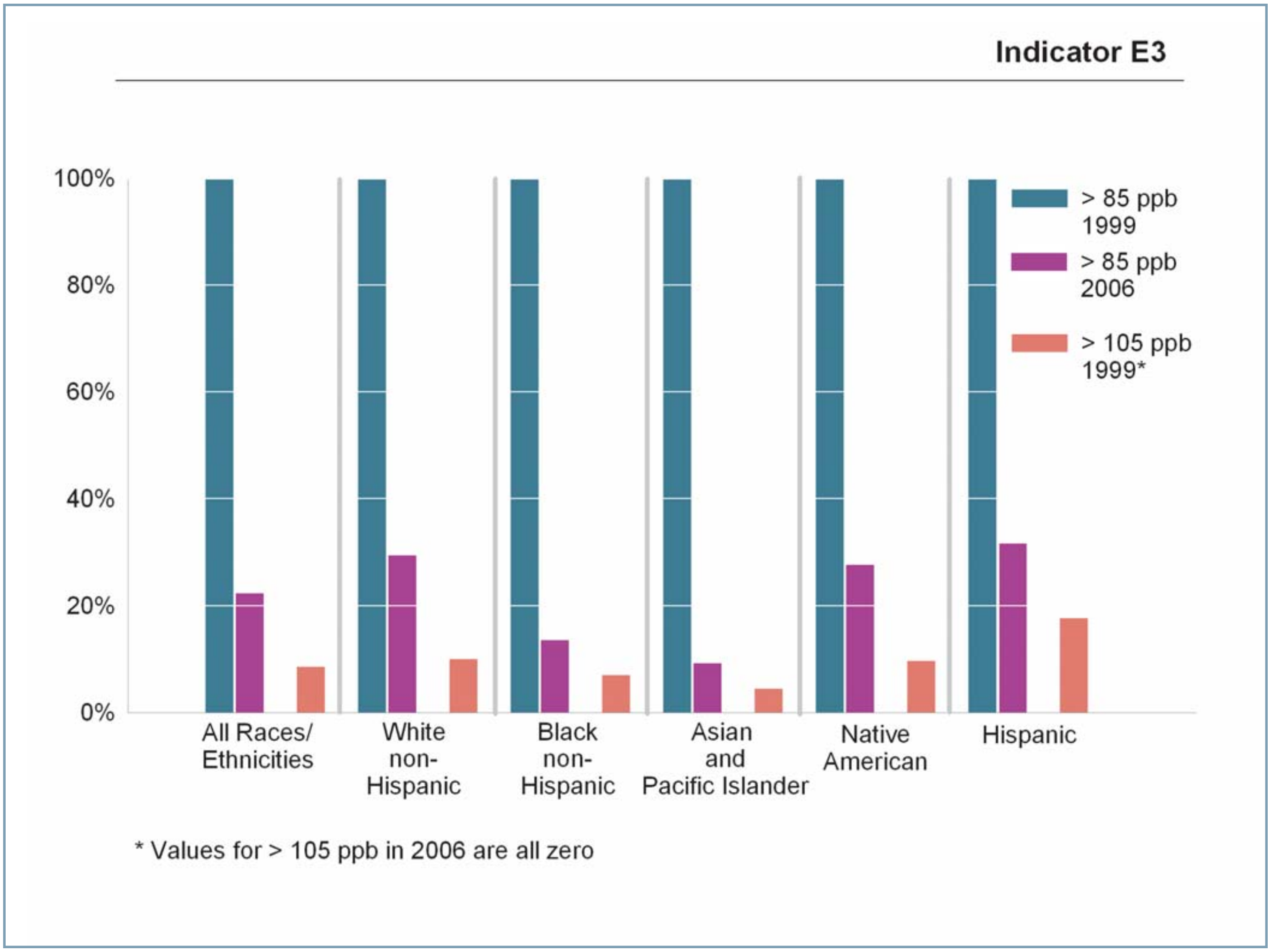

Figure 3. Percentage of Children Exposed to Ozone Above the National Standard (85 ppb), 1999 – 2006
Source: Maryland Department of the Enrivonment

Indicator E3: Percent of Children Exposed to Annual Ozone Concentrations Above the National Standard by Race

In order to examine the distribution of exposures, the ozone maps in Figure 2 have been merged with census data to estimate ozone exposures among children by race. See Figure 3.

- The percentage of children exposed to elevated long-term ozone levels decreased in the period from 1999 to 2006.
- This decrease was seen in children of all ethnic groups.

Healthy People 2010: Objective 8-01 of Healthy People 2010 aims to reduce the proportion of persons exposed to air that exceeds the levels of U.S. EPA's health-based standards for harmful air pollutants.

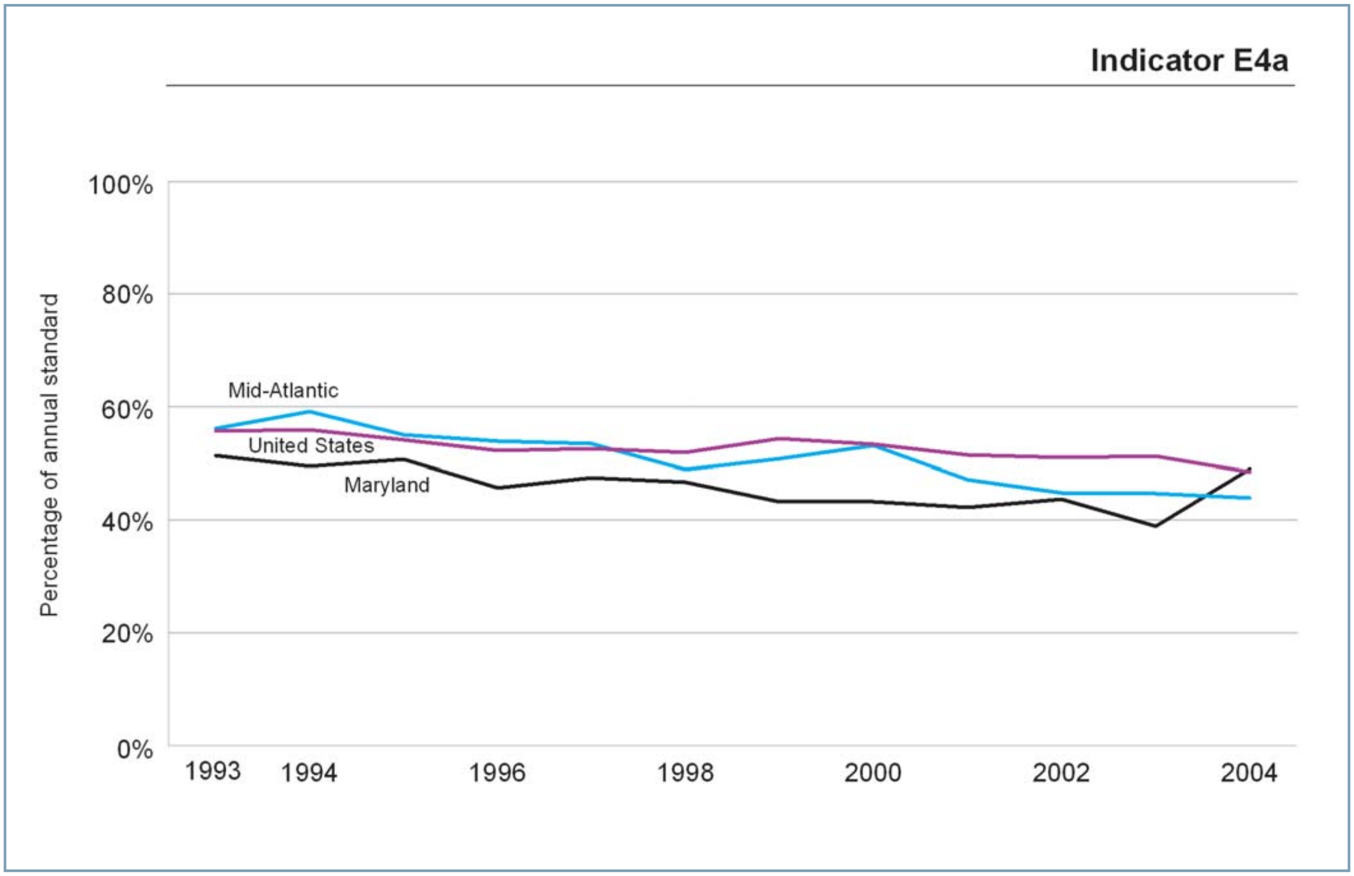

Figure 4. Average Annual Concentrations of Particulate Matter, 1993 – 2004
Source: US Environmental Protection Agency, Office of Air and Radiation, Aerometric Information Retrieval System

Indicator E4: Trends in Annual Average PM_{10} and $PM_{2.5}$ Concentrations

Figures 4 and 5 show statewide annual average $PM_{2.5}$ and PM_{10} concentrations at stationary monitors and how they have changed relative to national standards. These average values have been adjusted to give more weight to counties with large numbers of children (see Appendix B).

- Since reliable $PM_{2.5}$ monitoring results became available in 2000, the statewide annual averages have remained near the national standard. The trend line suggests some improvement.

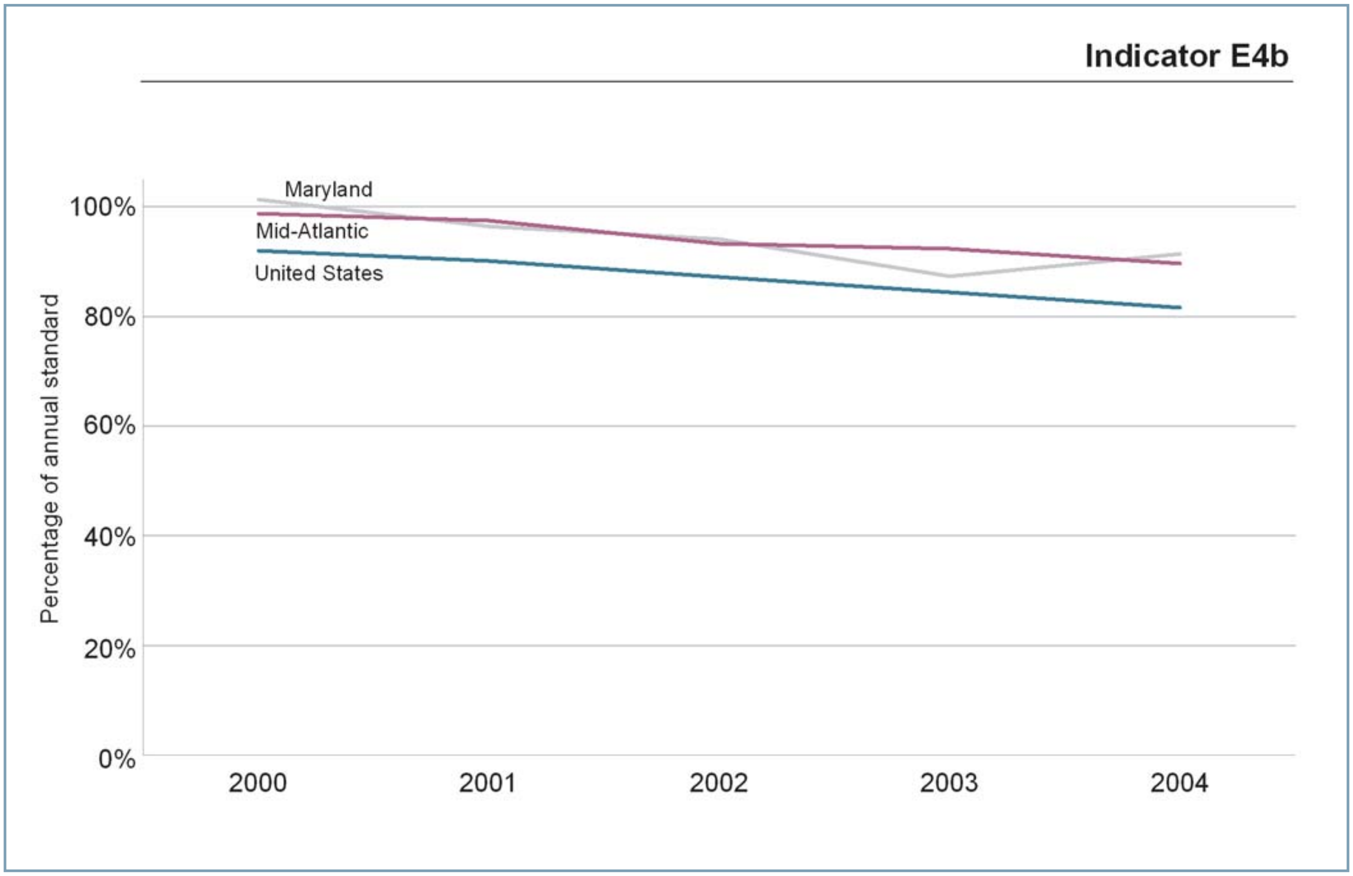

Figure 5. Estimated Exposure of Children to $PM_{2.5}$, 2000 – 2004

Source: US Environmental Protection Agency, Office of Air and Radiation, Aerometric Information Retrieval System

- PM_{10} averages have remained at approximately one-half of the national standard since 1993.

Healthy People 2010: Objective 8-01 of Healthy People 2010 aims to reduce the proportion of persons exposed to air that exceeds the levels of U.S. EPA's health-based standards for harmful air pollutants.

Indicator E5: Percentage of Children Living in Counties Where Estimated Hazardous Air Pollutant Concentrations Were Greater Than Health Benchmarks

This indicator shows the extent to which outdoor air toxics in Maryland in 1999 created increased risks of cancer and other health effects (see Figure 6). A 1-in-100,000 cancer benchmark means that one additional case of cancer is expected to occur in a population of 100,000 people exposed for a lifetime to the air toxics levels similar to those existing in 1999. The 1-in-100,000 and 1-in-10,000 benchmarks are commonly used goals in the control of air pollution. The third benchmark deals with health effects other than cancer; it corresponds to a daily exposure to a combined level of air toxics having essentially no risk of deleterious non-cancer effects (Appendix A).

All sources of pollution (point, area, and mobile sources) and nearly all of the 188 air toxics are combined in these analyses. The exposures are assumed to be continuous over a lifetime. The analyses do not predict the risks of disease living close to specific sources or the risks associated with indoor air pollution.

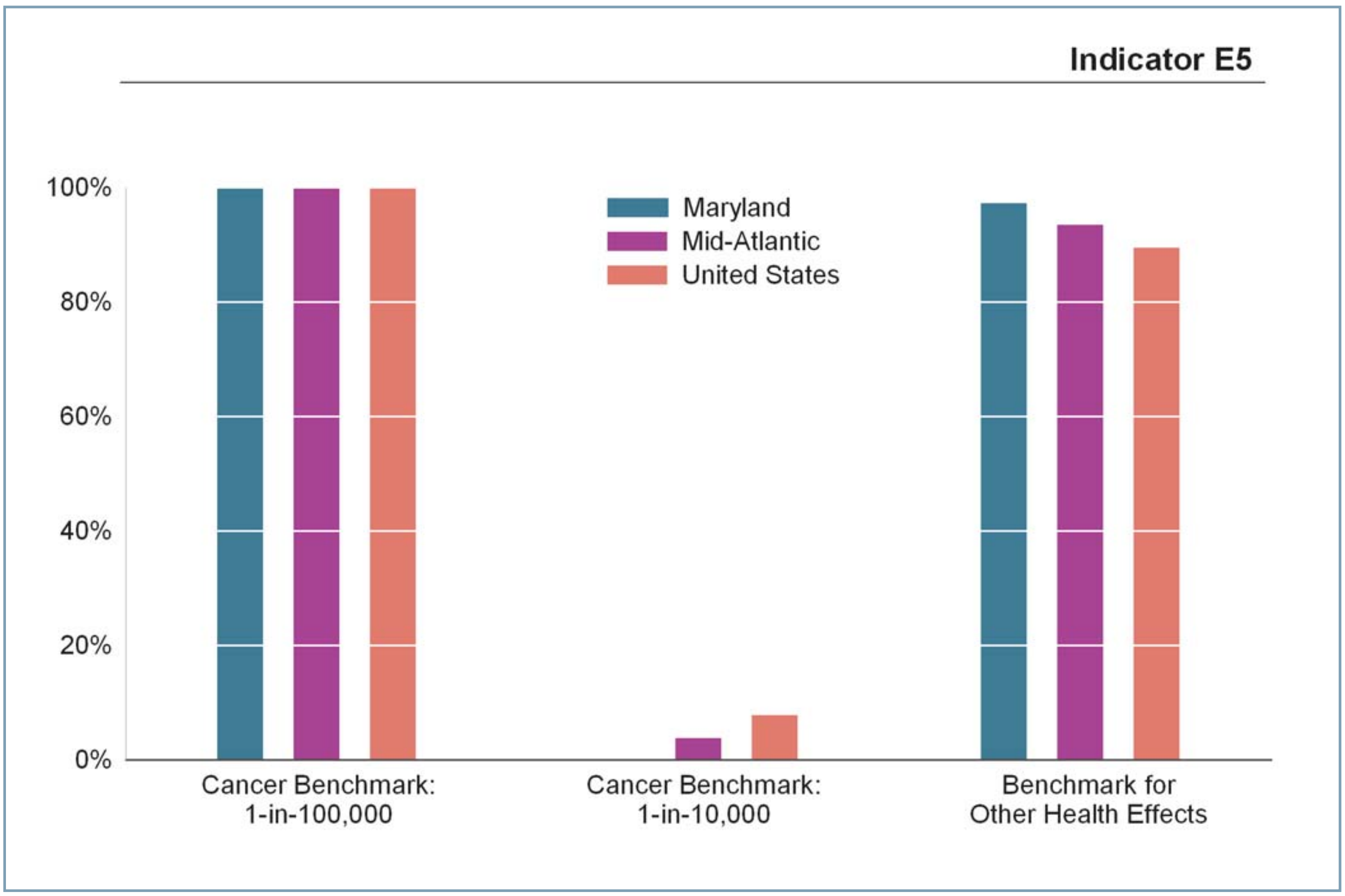

Figure 6. Percentage of Children in Counties where Hazardous Air Pollutants Exceeded Benchmarks in 1999

Source: US Environmental Protection Agency, National Air Toxics Assessment

- In 1999, all U.S. and Maryland children lived in counties where the combined concentrations of outdoor air toxics exceeded the 1-in-100,000 cancer risk benchmark. About 8 percent of U.S. children lived at concentrations above the 1-in-10,000 cancer risk benchmark; the percentage of Maryland children in this risk category was essentially zero.

- Benzene, 1,3-butadiene, and chromium compounds were at the top of the list of known carcinogens contributing to overall risk. The majority of benzene and 1,3-butadiene comes from mobile sources.

- In 1999, most children lived in counties where at least one outdoor toxic air pollutant exceeded the benchmark for non-cancer health effects: 97 percent in Maryland and 89 percent in the U.S. In most places, acrolein, a respiratory irritant, was the primary cause of elevated risk. The majority of acrolein comes from mobile sources.

Healthy People 2010: Objective 8-04 of Healthy People 2010 focuses on reducing emissions of hazardous air pollutants.

1.2 Indoor Pollutants

Americans spend approximately 90 percent of their time indoors where air contaminants and associated health risks are generally greater (EPA, 2008a). Major sources of indoor pollutants include:

- Combustion (carbon monoxide and fine particles from cooking, heating)
- Building materials and furnishings, such as treated wood, lead paint, and carpeting
- Products used indoors (cleaning products, pesticides, glues and adhesives, paints)
- Biological sources (mold, mildew, pet dander, insects and arthropods)
- Environmental tobacco smoke
- Outside sources (through windows, doors, walls)
- Vapors or gases coming into the crawl space or basement from underground (including radon)

Indoor air pollutants can cause or worsen certain children's health problems, such as allergies, asthma, respiratory irritation, and middle ear conditions. Long-term risks may include increased risk of cancer, heart disease, and reduced lung function later in life. In this report we focus on two particular pollutants, environmental tobacco smoke and lead, because of their significant health effects and the concerted historical efforts to reduce exposures and health outcomes. It should be noted that unlike outdoor air pollutants, there is no mandated federal or state surveillance system for indoor air pollutants, so there is no systematic collection of data on indoor environmental air pollutants.

Environmental Tobacco Smoke

Environmental tobacco smoke (ETS), also known as secondhand smoke, is a mixture of more than 3,800 different chemical compounds generated by the burning of tobacco products (NRC, 1986). Where it occurs, it can be an important contributor to illnesses in children. In 2005, estimated medical costs associated with illnesses and deaths due to passive smoking were $523.8 million for adults and $73.8 million for children (Waters, 2006). The lungs of children appear to be most susceptible to the effects of ETS due to the fact that children are still developing physically and have higher breathing rates than adults. Children who are exposed to ETS are at increased risk for asthma, bronchitis, pneumonia, middle ear infections, and sudden infant death syndrome.

The harmful effects of exposure to ETS among children may vary by race. Despite the lower levels of reported exposure to ETS, African American children have higher levels of serum cotinine (a marker of tobacco exposure in the blood) (Wilson et al., 2005). The reasons for this are not understood, but it has been hypothesized that racial differences in the metabolism of tobacco toxicants as well as housing may explain the differences.

Lead Exposures in the Home

Lead is a heavy metal with no known biological function in the human body. Lead causes a number of health problems, including learning disabilities and behavioral problems (see also section 4.1). Children can be exposed to lead from the air, soil, and drinking water, but the highest exposures in the population are from lead paint in houses and apartments built before 1978, when lead paint was banned in the United States. Houses built before 1950 can contain paint with even higher amounts of lead. As of 2000, approximately 20 percent of U.S. homes had significant lead-based paint hazards in the form of deteriorated paint, dust lead, or bare soil lead (Jacobs et al., 2002).

Much effort is directed toward abatement and enforcement of regulations related to lead-contaminated housing in Maryland. Multi-agency partnerships with the local and state agencies, schools, and healthcare providers focus on active follow up of at-risk children, moving families to safer housing, and enforcement of lead paint laws. As of 2006, Maryland requires all pre-1950 rental dwellings to be in compliance with the Full Risk Reduction Standard. Landlords must perform risk reduction work when conditions warrant and verify that properties are lead-free at the time of turnover to new occupants.

Indicator E6: Percentage of Households Where Minors Age Less Than Five Have an Adult Smoker Resident

This indicator for ETS shows the percentage of homes with children less than five years of age in which there is an adult smoker resident (see Figures 7 and 8). The data are derived from the Maryland Annual Tobacco Survey and are available for 2000 and 2002(DHMH, 2002; DHMH, 2003). This is an indirect measure because it reflects the percentage of homes, which is expected to track closely with the number of children. Serum cotinine is a better measure to quantify exposure to ETS and its health effects, but these data are not available for young children; the National Health and Nutrition Examination Survey (NHANES)

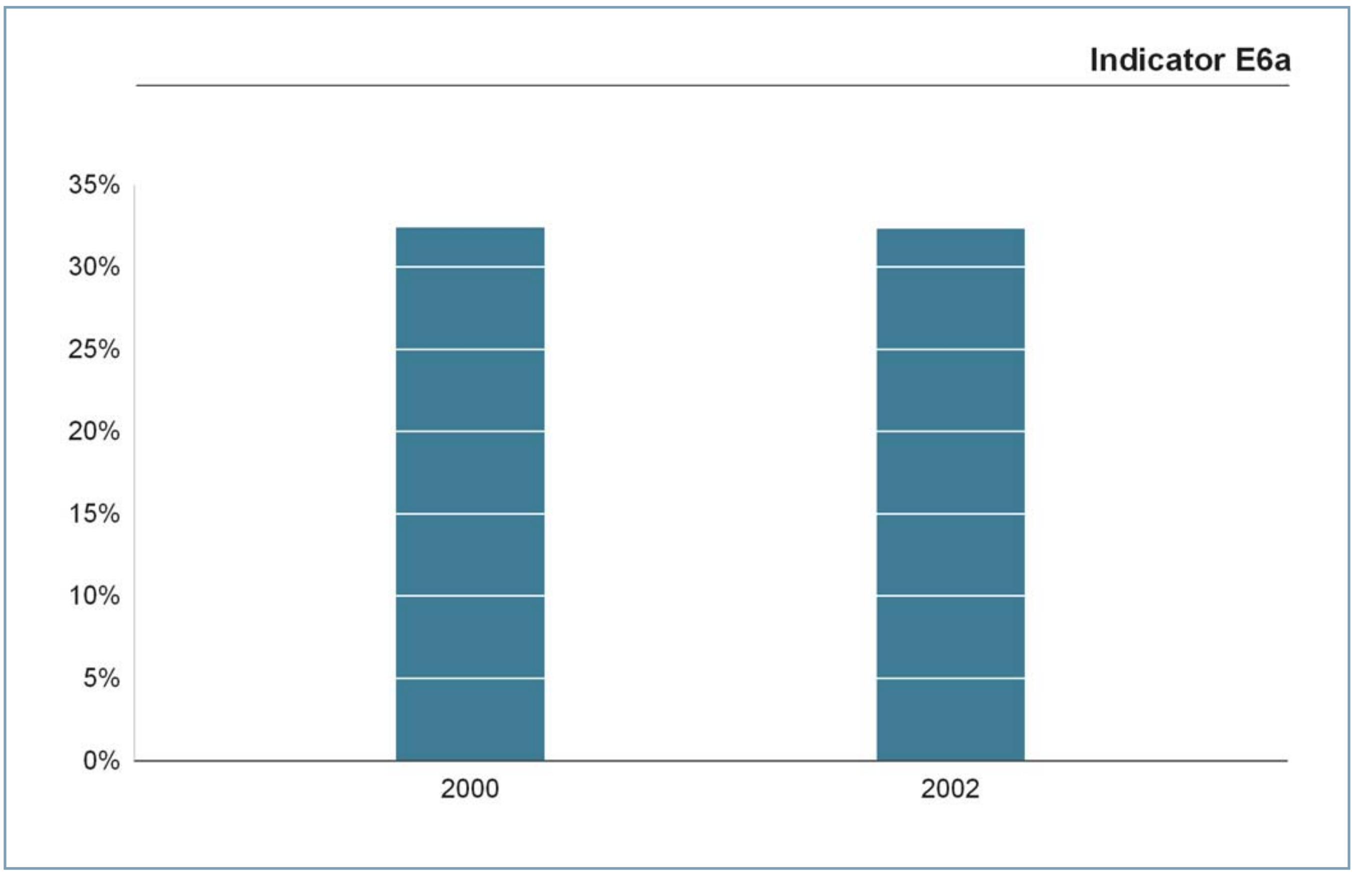

Figure 7. Percentage of Homes with Children Under 5 Years and Smoking, 2000 & 2002
Source: Maryland Tobacco Survey, Department of Health and Mental Hygiene

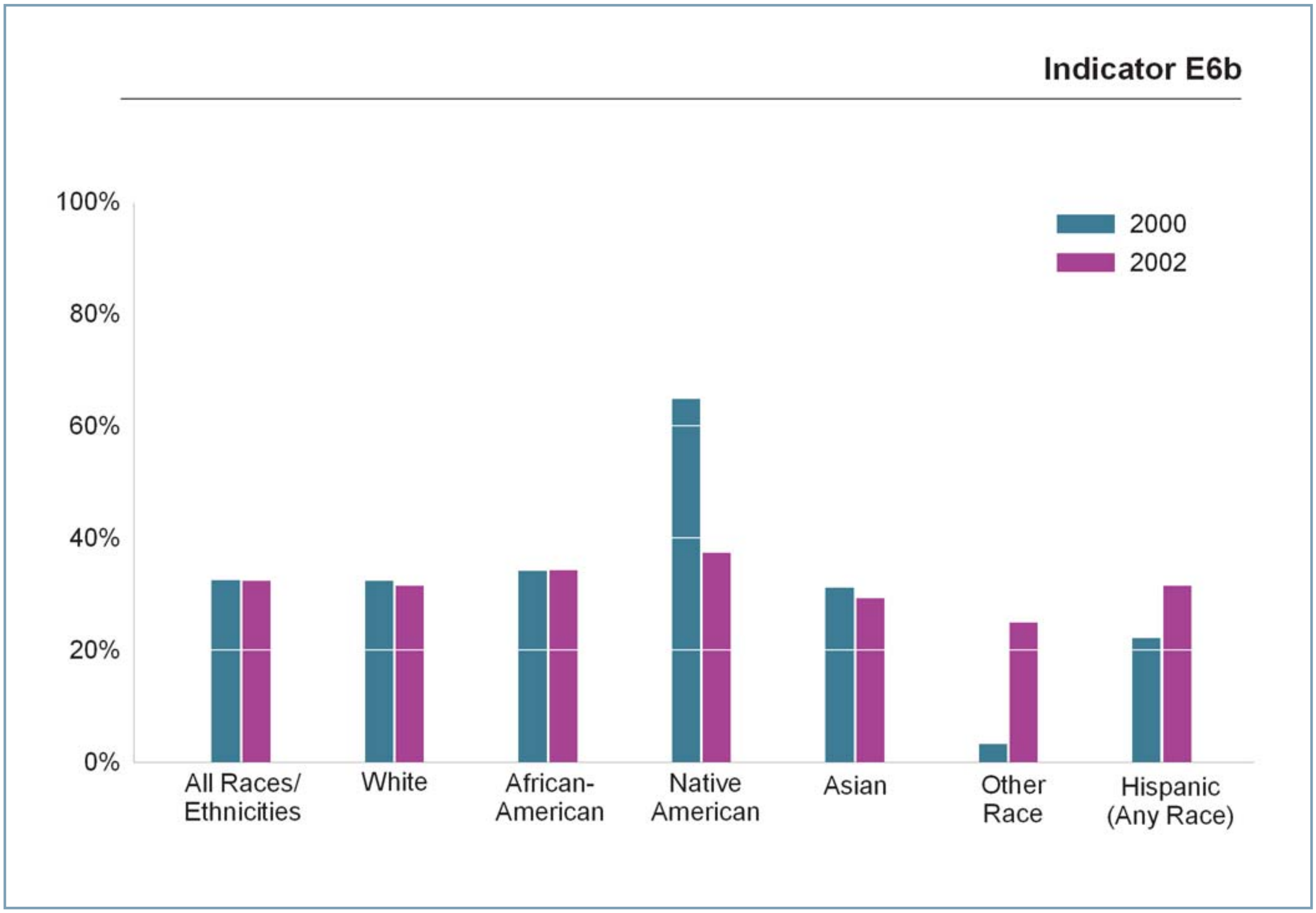

Figure 8. Percentage of Homes with Children Under 5 Years and Smoking by Race, 2000 & 2002
Source: Maryland Tobacco Survey, Department of Health and Mental Hygiene

sponsored by the Centers for Disease Control and Prevention (CDC) collects data for children six years old and older.

- In Maryland, approximately 32 percent of children were exposed to ETS in their own homes in both 2000 and 2002. By comparison, a national EPA survey in 2003 showed that 11 percent of children under age six were exposed regularly to ETS (EPA, 2004).

- African-American children were slightly more likely to be living in a household with a smoker (34.1 percent in 2000 and 32.3 percent in 2002) than were White children (32.3 percent in 2000 and 31.5 percent in 2002). It is important to note that there were only small numbers of children surveyed that were categorized as minorities other than Black; thus it is difficult to interpret these findings.

Healthy People 2010: Objective 27-09 of Healthy People 2010 focuses on reducing the proportion of children who are regularly exposed to tobacco smoke at home.

Indicator E7: Percentage of Women Who Smoke During Pregnancy

This indicator shows the percentage of expectant mothers who smoke in the last months of a pregnancy (see Figures 9 and 10). Smoking during pregnancy is associated with low birth weight, preterm birth, and neonatal and infant mortality. In addition, mothers who smoke during pregnancy put their babies at an increased risk of sudden infant death syndrome.

- In Maryland, the proportion of mothers who smoked during the last three months of pregnancy over a five-year period of 2001 – 2005 was approximately 10 percent.
- White pregnant women were more likely to smoke than Black women at 12 percent compared to 7 percent, respectively.

Healthy People 2010: Objective 27-06 of Healthy People 2010 focuses on increasing smoking cessation during pregnancy.

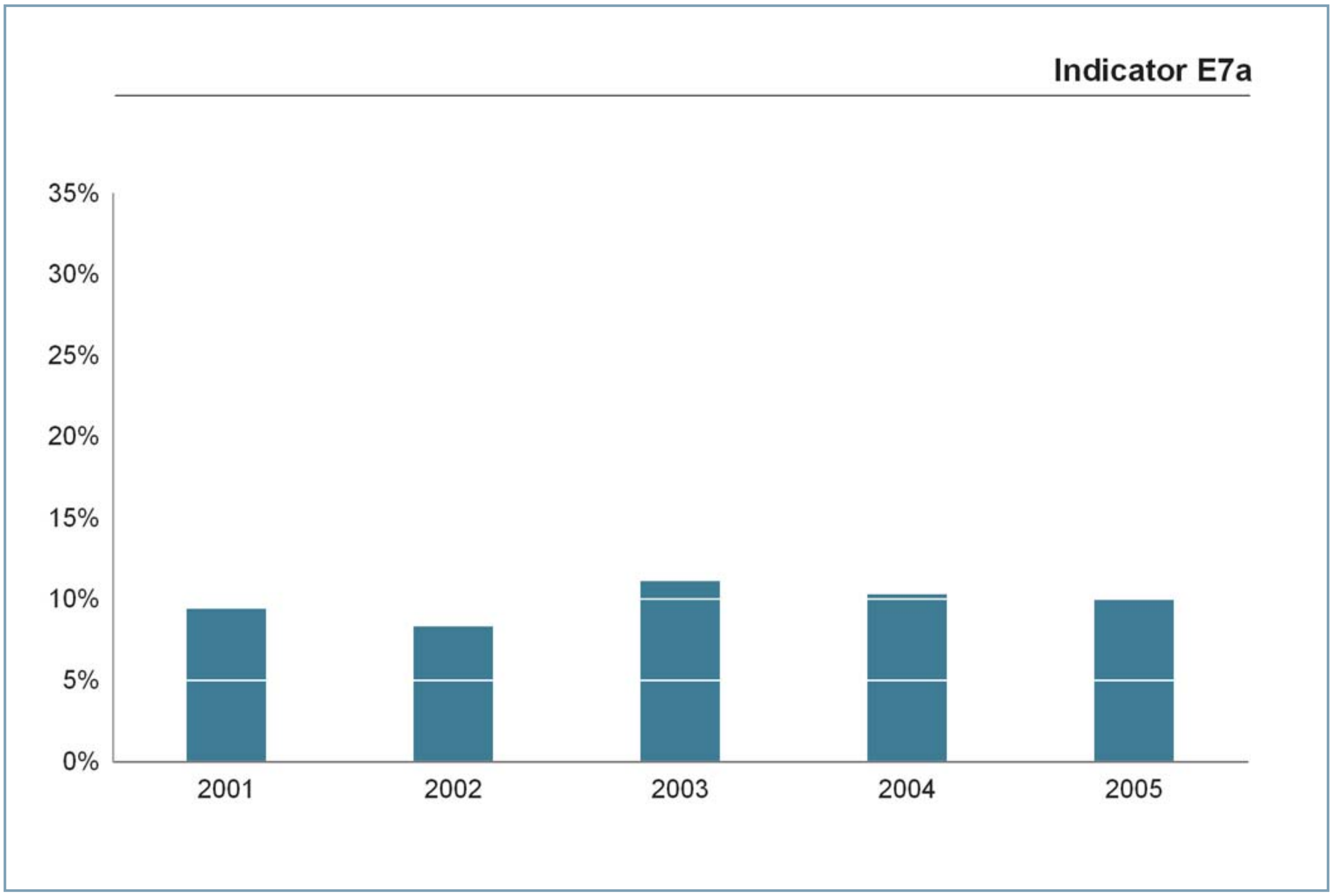

Figure 9. Percentage of Women who Smoked During the Final 3 Months of Pregnancy, 2001 – 2005

Source: Maryland Tobacco Survey, Department of Health and Mental Hygiene, 2000 & 2002

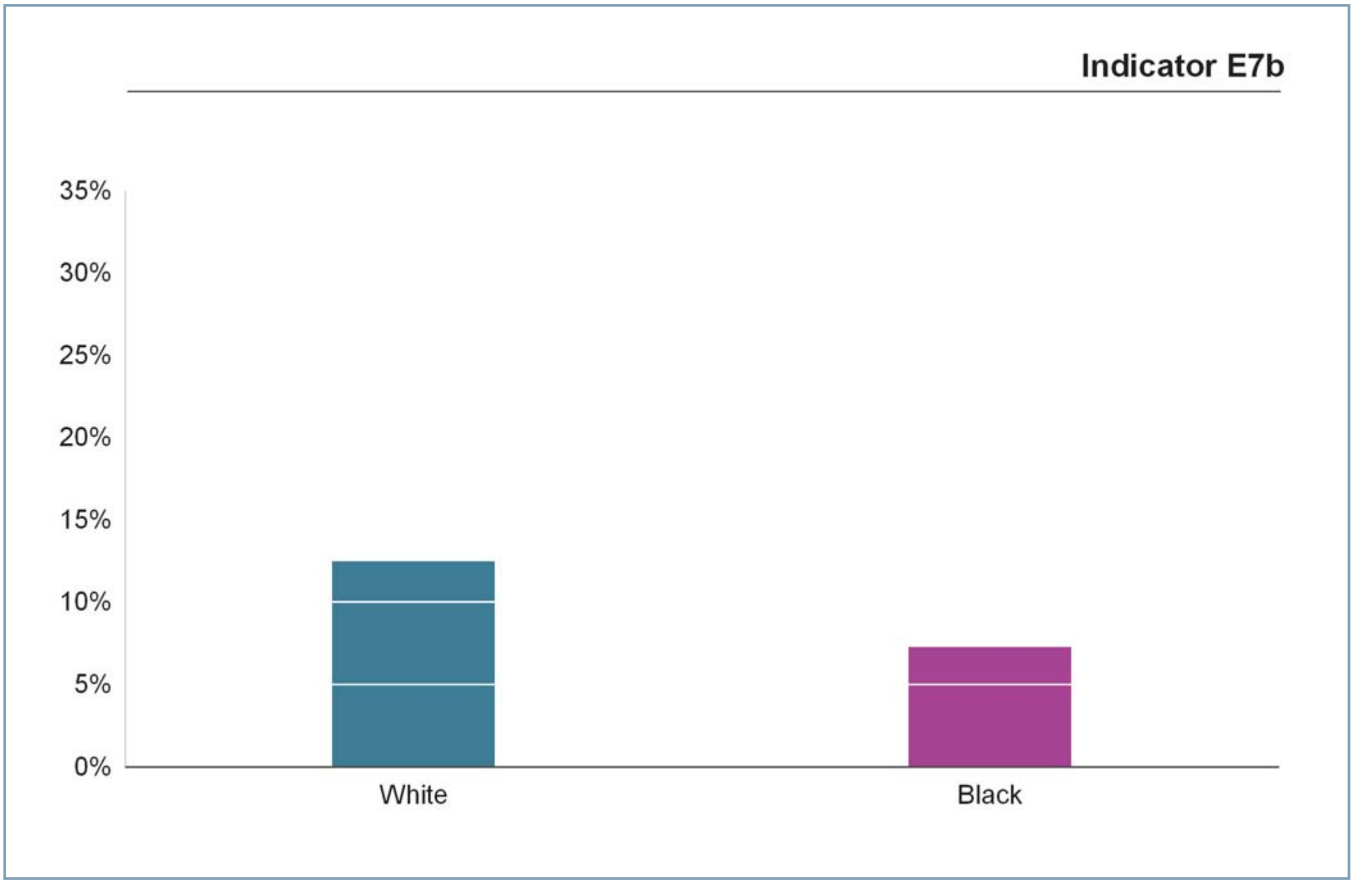

Figure 10. Percentage of Women who Smoked During the Final 3 Months of Pregnancy, by Race, 2001 – 2005
Source: Maryland Tobacco Survey, Department of Health and Mental Hygiene, 2000 & 2002

Indicator E8: Proportion of Housing Stock Built Before 1950

This indicator shows the trend in the percentage of housing units built before 1950 (see Figure 11) and therefore potentially posing a significant risk to children from lead dust and paint chips. The number of housing units is the total number of units, because data on the number of pre-1950 units with children are not available.

- In Maryland, the relative proportion of housing units built before 1950 decreased from 25 to 18.5 percent between 1990 and 2005. This is partly due to the availability of new houses built after 2000 and partly due to demolition of old units.
- The percentage of total housing units built before 1950 is slightly lower in Maryland than in the overall U.S.

Healthy People 2010: Objective 8-22 of Healthy People 2010 focuses on increasing the proportions of persons living in pre-1950s housing that has been tested for the presence of lead-based paint.

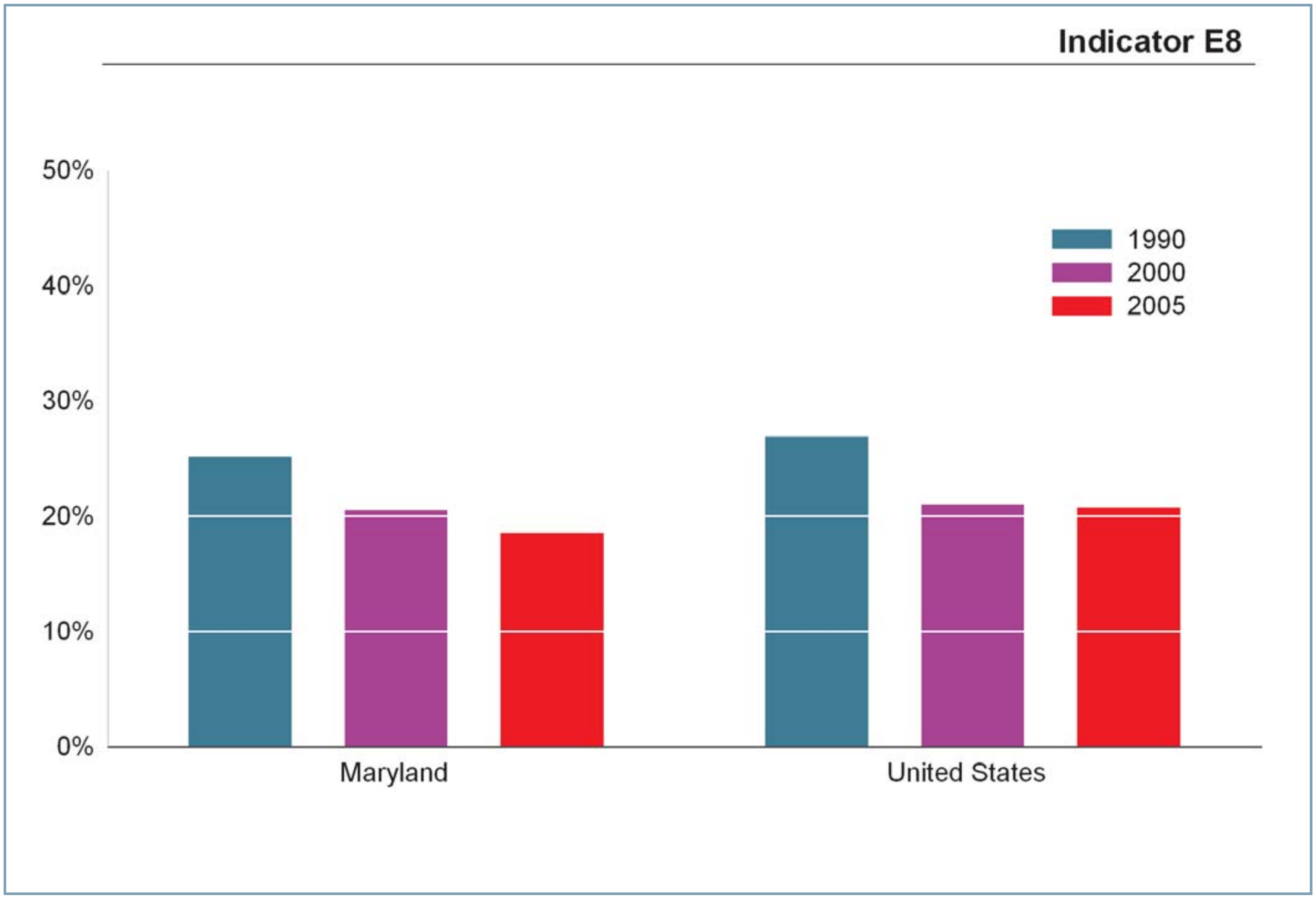

Figure 11. Percentage of Total Housing Units Built Before 1950
Source: U.S. Census 2000

Radon

Radon is a colorless, odorless radioactive gas which is found in almost all soil. The concentrations in soils vary geographically depending on soil chemistry. This gas can seep into homes and buildings through cracks in the foundation, where it can accumulate in high concentrations. The risk for exposure to radon is usually highest in basements and rooms with ground contact, as the gas dissipates in the upper floors of buildings.

Radon has been classified as a known human carcinogen by the International Agency for Research on Cancer (IARC). Evidence for this classification is based on studies of uranium miners exposed to high concentrations of radon gas. These studies demonstrated an increased risk of lung cancer when exposed to increasing levels of radon. The studies also showed a synergistic effect between radon exposure and smoking, with smokers exposed to radon having much higher rates of lung cancer compared with nonsmokers exposed to radon (IARC, 1998).

Table 2. Lifetime Risk* for Lung Cancer Due to Radon

Radon Level	Risk for Never Smokers	Risk for Smokers
20 pCi/L	36 per 1,000	260 per 1,000
10 pCi/L	18 per 1,000	150 per 1,000
8 pCi/L	15 per 1,000	120 per 1,000
4 pCi/L	7 per 1,000	62 per 1,000
2 pCi/L	4 per 1,000	32 per 1,000
1.3 pCi/L	2 per 1,000	20 per 1,000
0.4 pCi/L		3 per 1,000

*Risk if exposed to specific radon level over a lifetime
Source: EPA

Recently, analyses of studies performed in the U.S. and Europe have confirmed that there are increased rates of lung cancer among residents of homes found to contain elevated concentrations of radon (Darby et al., 2005; Krewski et al., 2005). Radon is believed to be the second leading cause of lung cancer, after smoking, and the leading cause of lung cancer among non-smokers. The EPA estimates that radon is responsible for approximately 21,000 lung cancer deaths in the U.S. each year, including 2,900 deaths among non-smokers (EPA, 2003).

The EPA strongly recommends that homeowners take action to reduce home radon levels if concentrations exceed 4 pCi/L (pico Curies per Liter). There is no known safe level for radon exposure, so the EPA encourages homeowners to reduce radon levels even if their homes are found to contain radon levels between 2 to 4 pCi/L. The average U.S. home is estimated to have radon levels of 1.3 pCi/L (Marcinowski et al., 2004), while the average outdoor concentration of radon is 0.4 pCi/L (EPA, 2008b).

There is currently no evidence that children are at increased risk from radon exposure compared to adults. However, like adults, children who spend large amounts of time in basements or rooms with ground contact will be at increased risk for lung cancer if the rooms have elevated radon levels. They are at further increased risk if they are also exposed to second-hand smoke.

Figure 12 shows the predicted county averages for indoor radon levels.

No indicator is proposed in this report for radon. However, as a recognized carcinogen and environmental hazard, radon should be considered for inclusion in future indicator activities or deliberations.

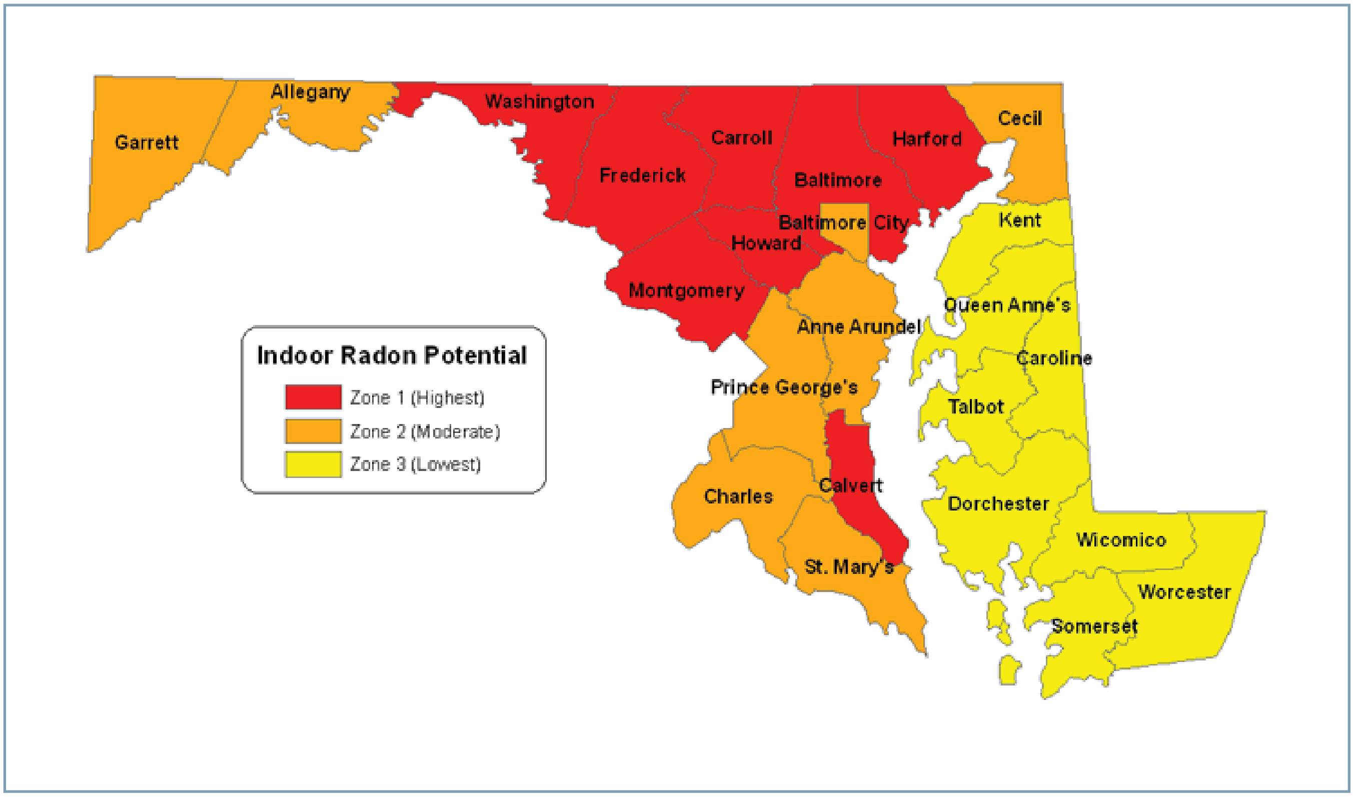

Figure 12. Maryland Radon Zones
Source: EPA at http://www.epa.gov/radon/zonemap/maryland.htm

Zone 1 counties have a predicted average indoor radon screening level greater than 4 pCi/L (pico curies per liter). Zone 2 counties have a predicted average indoor radon screening level between 3 and 4 pCi/L. Zone 3 counties have a predicted average indoor radon screening level less than 2 pCi/L.

Note: This map is not intended to be used to determine if a home in a given zone should be tested for radon. Homes with elevated levels of radon have been found in all three zones. All homes should be tested regardless of geographic location.

1.3 Drinking Water Contaminants

Contaminants in surface and ground waters have the potential to cause childhood diseases such as acute gastrointestinal illness, learning disorders, and cancer. Contaminants of potential concern include bacterial, viral, and other microbial pathogens in sewage, nitrates from fertilizer, the chemical by-products of disinfection (the process used to kill microbial pathogens), lead released slowly from indoor plumbing, arsenic and radioactivity occurring naturally in groundwater, gasoline from spills and leaks, and the pharmaceuticals and personal care products left untreated by sewage systems, among others. Threats to drinking water are controlled through the application of water quality standards, regulations, and best practices; these efforts usually succeed in reducing contamination to low levels where the chance of harm is small and adverse effects are difficult to detect.

The protection of drinking water in public water systems is the central goal of the Safe Drinking Water Act. About 85 percent of Maryland's population uses public water systems, defined as systems that provide piped water for human consumption to at least fifteen service connections or regularly serve twenty-five individuals. Public water systems that serve residents year-round are referred to as community water systems. There are approximately 3,600 public water systems and 500 community water systems in Maryland. The two largest community systems serve the metropolitan Baltimore and Washington areas, providing water for approximately 60 percent of the state's population (EPA, 2005).

Public water supplies are closely regulated because they serve relatively large numbers of people. A system may fail to comply with safe drinking water rules in three basic ways:

1. The contaminants in treated water must be kept below the legal standard. EPA has created drinking water standards for approximately ninety contaminants.

2. Raw water must be treated by approved methods before it is piped to consumers. Notices of violation are issued when a system fails to follow treatment protocols.

3. Scheduled monitoring is required to ensure that the system is functioning properly. Notices of violation are issued when a system fails to test for contaminants on the proper schedule and report the results on time.

The standards and requirements for treatment and reporting under the Safe Drinking Water Act do not apply to small private systems, many of which use domestic wells. These small private systems serve approximately 43.5 million people in the U.S. and 900,000 people in Maryland (approximately 15 percent of the population) (EPA, 2005). Wells must be properly constructed and tested before use, after which monitoring and maintenance are usually left in the hands of the property owner. Many of these private wells are in rural and agricultural areas and may be at increased risk from nitrate and fecal contamination, as well as contamination from local chemical spills, petroleum tanks, pesticides, and natural mineral deposits. The State of Maryland requires that new domestic wells be properly constructed and tested for bacteria, nitrates, and several other routine constituents. Local county health departments may require tests for arsenic, radiation, and other compounds as a result of local conditions.

Analysis of data from the Maryland Department of the Environment shows that the percentage of Maryland children not on public water systems gradually increased from 8 – 14 percent from 1993 to 2004. Because there is no routinely collected data on water quality from these wells, it is not possible to assess the risk to children's health from this source. This is a significant limitation in interpreting risk from water-borne contaminants in Maryland.

Indicator E9: Percentage of Children Served by Community Water Systems That Did Not Meet All Applicable Health-based Drinking Water Standards

This indicator shows the percentage of children using community water systems where a drinking water standard was exceeded or treatment requirements were not met. It illustrates the collective performance of community water systems although it does not represent the actual frequency, severity, and cumulative impact of violations. Drinking water rules are periodically updated, thus the changes shown in Figures 13 and 14 are sometimes due to changes in rules and standards rather than actual changes in water quality.

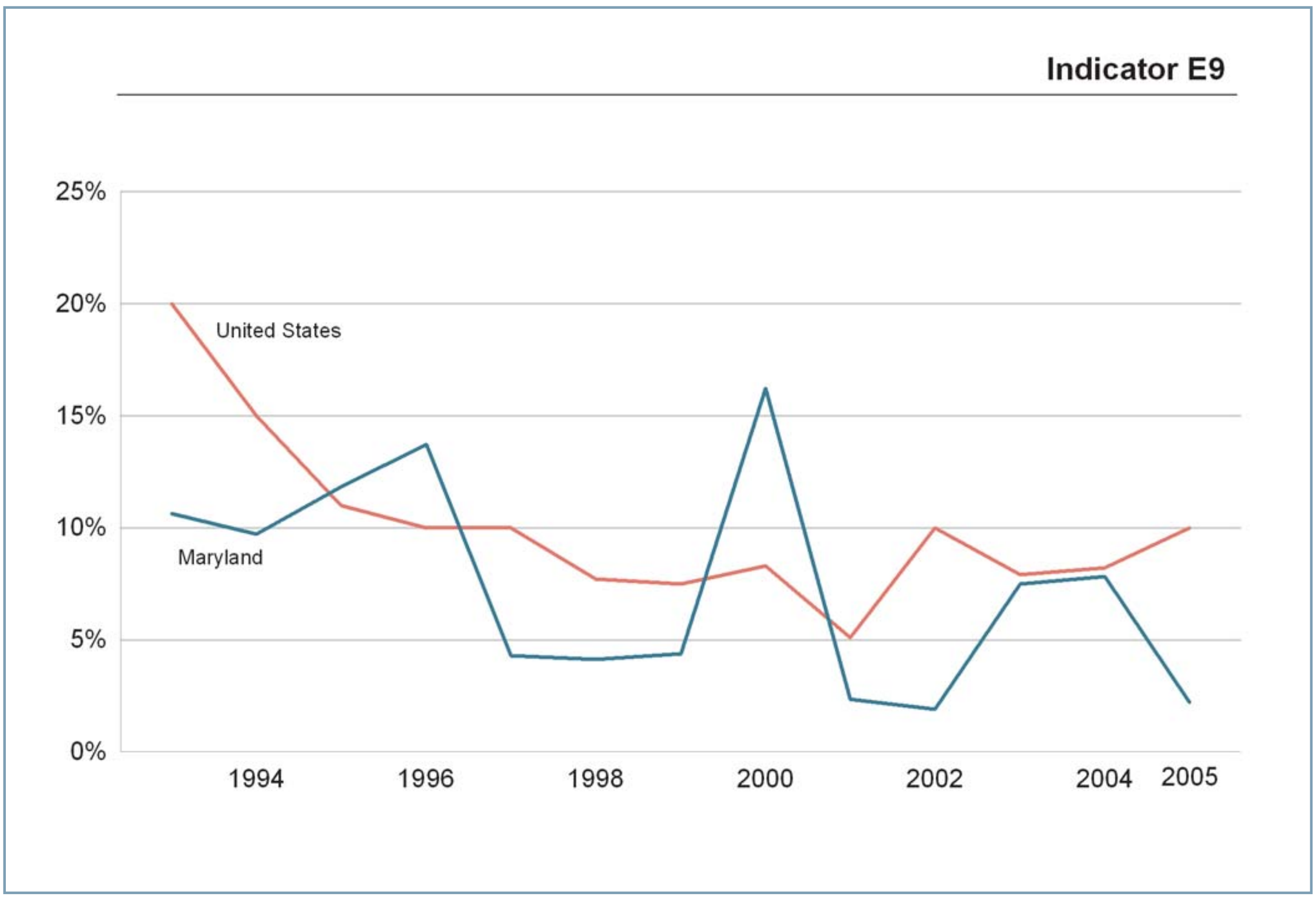

Figure 13. Percentage of Children Served by Community Water Systems that Exceeded at Least One Health-based Drinking Water Standard
Source: US Environmental Protection Agency, Office of Water, Safe Drinking Water Information System (percentages are estimated)

- Since 1993, a range of 2 – 16 percent of Maryland children and 5 – 20 percent of U.S. children have lived in areas served by community water systems that experienced one or more episodes of noncompliance with drinking water standards or treatment requirements. Single issues, such as elevated coliforms (bacteria, usually from contamination with sewage), tend to impact fewer than 5 percent of the childhood population. The peak in Maryland in 2000 was due to a treatment violation by a public water system in Baltimore City serving 1.6 million persons and an estimated 400,000 children.
- From 2004 to 2005, the percentage of children served by noncompliant systems in Maryland varied between racial and ethnic groups and between groups with household incomes above and below the poverty line. The percentages were highest for White non-Hispanic children and children living at or above the poverty line. No national comparison data are available.

Healthy People 2010: Objective 8-05 of Healthy People 2010 focuses on increasing the proportion of persons served by community water systems who receive a supply of drinking water that meets the regulations of the Safe Drinking Water Act.

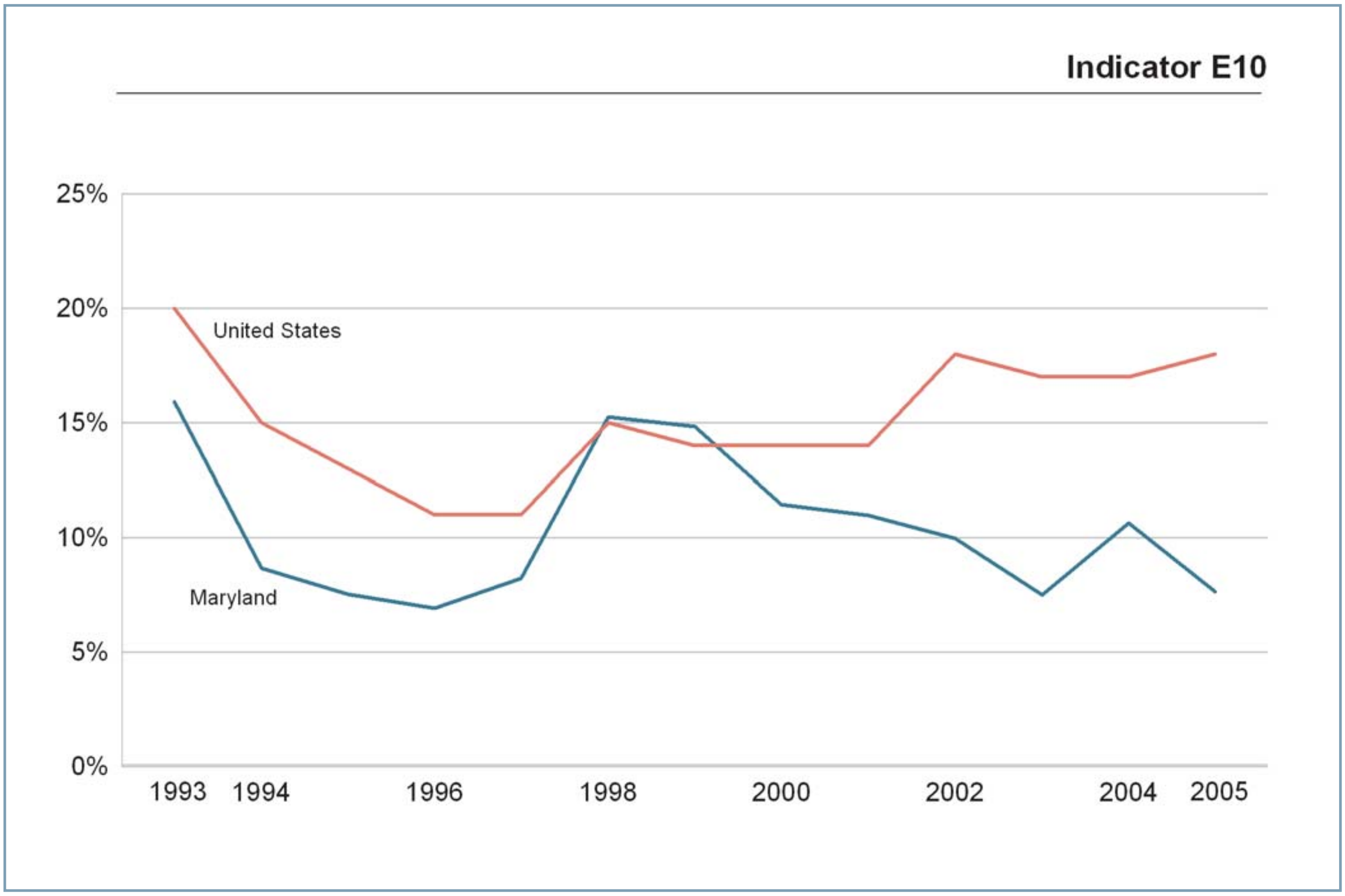

Figure 14. Percentage of Children Living in Areas Served by Community Water Systems with Violations of Drinking Water Monitoring and Reporting Requirements
Source: US EPA, Office of Water, Safe Drinking Water Information System (percentages are estimated)

Indicator E10: Percentage of Children Living in Areas Served by Community Water Systems With Violations of Drinking Water Monitoring and Reporting Requirements

This indicator shows the percentage of children using community water supplies that failed to correctly monitor or report their water quality. Without proper monitoring and reporting, episodes of poor water treatment and exposure to contaminants may not be detected in a timely fashion. The actual frequency and severity of monitoring and reporting violations are not reflected in this information.

- In the years since 1993, a range of 7 – 16 percent of Maryland children and 11 – 20 percent of U.S. children have lived in areas served by community water systems with at least one monitoring and reporting violation. The largest number of violations occurs in the category of lead and copper monitoring, which requires sampling in households throughout the community.
- In Maryland in 2004 – 2005, a range of 4 – 11 percent of children lived in areas served by water systems with violations in drinking water monitoring and reporting requirements. The percentages were highest for White Non-Hispanic and Native American children and children living at or above the poverty line. No national comparison data are available.

Healthy People 2010: Objective 8-05 of Healthy People 2010 focuses on increasing the proportion of persons served by community water systems who receive a supply of drinking water that meets the regulations of the Safe Drinking Water Act.

1.4 Pesticides

Pesticides are substances specifically produced and utilized to manage pests that are deleterious to humans and the human environment. Except for limited medical usages, they are not meant to be ingested or otherwise enter the human body. Specific categories of pesticides are in use to deter rodents (rodenticides), insects (insecticides), unwanted plants (herbicides), and fungi (fungicides).

Children may be unintentionally exposed to these products through contaminated food and water, by hand-to-mouth activity after contact with the product on floors and other surfaces, and by inhalation into their lungs and absorption through their skin following application of pesticides. Young children may also be exposed to pesticides by accidental ingestion of household or other products. Children can also potentially be exposed to these products through consumer use in their homes, schools and play areas, as well as through environmental contamination from farming and industrial usages. Children whose families work as pesticide applicators may be exposed through products brought into the home on their parent's work clothes. Young agricultural workers or children of agricultural workers may be contaminated in fields when inappropriate work practices exist.

Chemicals of particular concern are those that are persistent in the environment and enter drinking water or the food chain. Certain pesticides found to be long-lasting in the environment or highly toxic have been banned for use in the United States. These include substances such as DDT and other long-lived organochlorine products as well as some short-lived but highly toxic organophosphate insecticides. The EPA sets limits on pesticide residues on both domestic (interstate) and imported foods. However, some banned products are still used in international settings.

The effects of pesticides on children depend on the specifics of the chemical, the dose, and route of exposure. For example, at sufficiently high exposures, rodenticides can cause internal bleeding and organophosphates can lead to respiratory muscle paralysis, seizures and coma. Low-level exposures are much more common, but the adverse effects are harder to measure. Chronic, low-level exposures have been connected to neurologic and developmental findings, cancer, particularly central nervous system tumors and leukemia, as well as effects on reproductive organs. Much remains to be learned about the effects of these chemicals on children's developing organ systems.

There have been efforts to reduce pesticide exposures in children in Maryland. Maryland now requires parental notification when pesticides are applied in public schools and on school grounds (Md. Code Ann., Agricultural Article §5-208.1; COMAR 15.05.02). The Maryland Department of Agriculture, which regulates pesticide application and licenses applicators, promotes the use of integrated pest management (IPM) and pesticide application techniques that reduce potential exposures.

Data about pesticide use, exposures and pesticide-related illnesses exist but are limited. Surveys are used to collect information from commercial, private pesticide applicators, farmers and growers about when, where, and how they have applied pesticides. Researchers use crop patterns to predict the locations of agricultural pesticides. Public health agencies test food and raw and unfiltered drinking water. The CDC tests the blood and urine of U.S. residents to determine background levels and monitor trends in the population-at-large; the "Report on Human Exposure to Environmental Chemicals" includes biologic monitoring data in children as young as six years of age. (CDC, 2005)

In Maryland, the Maryland Poison Center and the state's Hospital Discharge Database capture information about acute pesticide poisonings. Although pesticide-related illnesses are reportable in Maryland, many mild-to-moderate symptoms of pesticide toxicity could easily be attributed to other conditions and cases are generally not reported to the state. More subtle illnesses from low-level pesticide exposures remain difficult to identify and diagnose, and effective surveillance systems for these types of illnesses do not exist. More research, including biological monitoring and epidemiologic studies, will be needed to clarify any contribution of childhood pesticide exposure to conditions that are being recognized more frequently in Maryland children in the twenty-first century, such as neurodevelopmental disturbances and asthma.

E11: Number of Pesticide-related Exposures in Children Reported to Maryland Poison Center

Two poison control centers serve Maryland: the Maryland Poison Center (MPC) at the University of Maryland School of Pharmacy, and the National Capitol Poison Center in the Washington metro area. Parents and children are familiar with and are encouraged to keep the phone number of a Poison Center readily available to call for advice in case of ingestion or other exposure to a toxic substance. Trends in the number and types of calls (see Figure 15) provide a glimpse of children's acute pesticide exposures, or at least concerns, in homes and other sites. Data are available by substance as well as by demographic characteristics of the subject of the call. It should be noted that while calls are verified where possible to ensure they refer to actual cases, the Poison Centers cannot determine the outcome of the cases or the severity. In general, drugs and cleaning agents are the most common agents for which the poison control centers receive calls (Maryland Poison Center, 2006).

- Each year, the Maryland Poison Center receives over 600 calls about children less than five years of age for pesticide-related concerns. In 2005, these calls represented 6 percent of all calls and included informational requests as well as reports of exposure. Most of these calls concerned insecticides, rodenticides, and insect repellents.

Healthy People 2010: Objective 8-13 focuses on reducing pesticide exposures that result in visits to a health care facility.

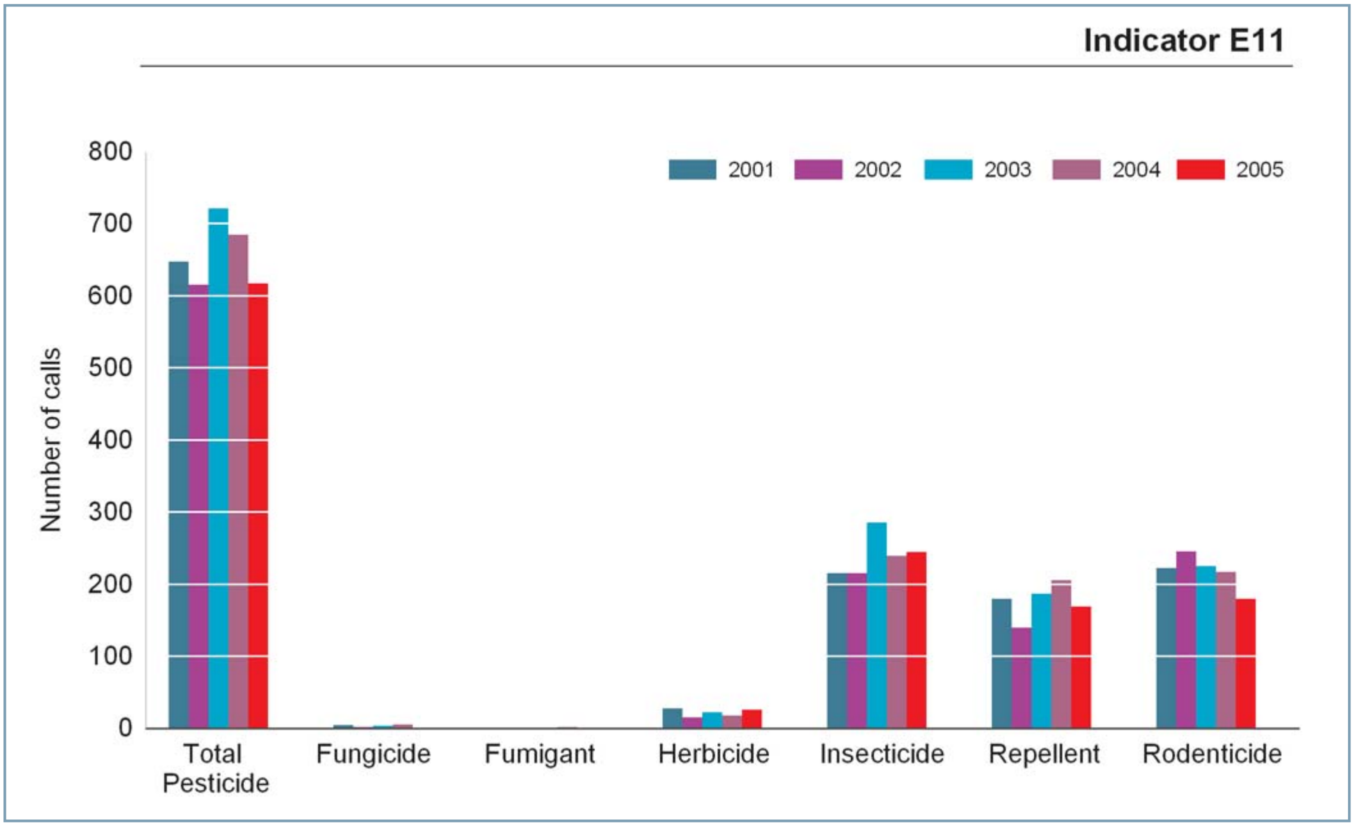

Figure 15. Pesticide-related Calls to Maryland Poison Center, 2001 – 2005
Source: Maryland Poison Center

1.5 Hazardous Substance Sites

The term "hazardous substance sites" refers to sites where hazardous substances have been improperly discarded or abandoned and present a threat of being released into the environment. In these settings, hazardous substances may migrate off-site, contaminating soil, water, air, and buildings on nearby properties. Maryland's 300-year industrial history has created a legacy of impacted properties requiring assessment and cleanup to protect public health.

Living, working, or playing near a hazardous substances site does not automatically represent a danger. A number of factors determines the risk associated with a site, such as the toxicity of the materials, their ability to move off-site, the distance to nearby populations, local geologic and hydrologic conditions, and access to the site by members of the public. When discovered, hazardous substances are controlled in several ways: contaminated soils and materials may be removed, restrictions may be placed on the use of the property and the use of local groundwater, and physical barriers such as paving and fencing may be installed.

Newly-identified sites of concern are evaluated in a systematic fashion to establish whether hazardous substances are present and whether they represent an active or potential risk to human health and the environment. The Maryland Department of the Environment evaluates risks to humans and wildlife, both on and off the property. This information is used to guide corrective actions.

Several categories of hazardous substances sites exist in Maryland. Many of the sites that are identified by the categories listed below may either have been remediated or are being assessed to determine potential risk to human health.

- ***Superfund sites.*** Also called National Priority List (NPL) sites, these sites pose the most significant risk to human health and the environment based on a grading system developed by the EPA. EPA and MDE coordinate the clean-up of these sites in Maryland.
- ***State Master List sites.*** These sites are also found on the federal Comprehensive Environmental Response, Compensation, and Liability Act Information System (CERCLIS) database. These sites have been identified as either contaminated or perceived to be contaminated, but have not scored high enough using EPA's Hazard Ranking System to justify placing the site on the NPL. They usually present low or moderate risk to human health and the environment. MDE is responsible for their investigation and clean-up.
- ***Brownfield sites.*** These are sites where contamination, or perceived contamination, hinders the redevelopment or reuse of real properties. Such sites are typically abandoned or under-utilized industrial or commercial properties with real or perceived contamination. However, they also can include agricultural or residential properties where hazardous substances and/or petroleum have been or may have been released into the environment. In Maryland, these sites are being returned to use through the Voluntary Cleanup Program (VCP), the Controlled Hazardous Substance (CHS) Enforcement Program or the Hazardous Waste Enforcement Division at MDE.

Actual chemical exposures and health impacts in populations are difficult to measure and are not routinely collected. No indicator of either exposure or health impacts is readily available for hazardous substance sites in Maryland, and thus none is proposed in this report.

Healthy People 2010: Objective 8-12 of Healthy People 2010 focuses on minimizing the risk to human health and the environment posed by hazardous sites.

1.6 Contaminants in Fish

Fish are an important part of a healthy diet. They contain high-quality protein, essential nutrients, and omega-3 fatty acids, all of which can contribute to a child's proper growth and development. Fish are also recommended in the adult diet and contribute to a healthier heart.

Low levels of chemical contaminants are usually present in fish. To ensure that the health benefits outweigh the risks, it is important to know which fish are likely to be contaminated and to eat them in moderation or avoid them altogether. Eating fish low in contaminants is particularly important for women who are pregnant or may become pregnant, women who are nursing an infant, and young children. In Maryland, methylmercury and PCBs (polychlorinated biphenyls) are the primary contaminants of concern. Both have the potential to influence a child's neurological development, including subtle effects on intelligence, language development, attention, and memory.

Methylmercury and PCBs are global contaminants that enter the environment and pass up the food chain. Mercury can occur naturally but is in greater quantity in air, water, and food due to coal burning, incinerators, and industrial activity. In water environments, mercury may be converted to methylmercury and concentrate through the food chain, concentrating more in some fish species than others. In a national survey, 6 percent of women of childbearing age have methylmercury levels within a factor of 10 of the levels associated with neurodevelopmental effects in the fetus (CDC, 2005). PCBs are manmade chemicals that were used in electrical equipment and many other products until they were banned in the 1970s. Because of their chemical stability, they continue to persist and cycle in the environment at low levels. Fish, meat, and dairy products are our primary sources of exposure.

Pollution laws, environmental clean-ups, monitoring and public information are used to minimize human exposures to these compounds. Commercially sold fish, which are eaten more often and by more people, are monitored by the U.S. Food and Drug Administration and the EPA. These agencies recommend that women and young children eat two meals a week of a variety of fish low in mercury and avoid eating ocean species known to be high in mercury (shark, swordfish, king mackerel, and tile fish; http://www.epa.gov/waterscience/fishadvice/advice.html). Individual states monitor the populations of recreational fish. As of 2004, forty-four states had recommended that women and children limit consumption of one or more local fish species as a result of methylmercury. Maryland's advisories are created by the Maryland Department of the Environment and posted at http://www.mde.state.md.us/CitizensInfoCenter/FishandShellfish. These are updated as needed to reflect new information about the health risks and new results from fish monitoring.

Indicator E12: Average Concentrations of Contaminants in Recreational Fish

In Maryland, fish from most major water bodies have been tested for contaminants, and recommendations have been issued for fish species and crabs where warranted. Black bass (a group that includes both large and small mouth bass) is a useful group for following the occurrence of methylmercury in lakes, reservoirs, and streams, where mercury is the most common problem (see Figure 16). White perch are a useful indicator of PCB contamination in the tidal tributaries of the Chesapeake Bay, where PCBs are the most common cause of fish consumption advisories (see Figure 17).

- Contaminants can be found in both commercial and recreational fish. The majority of waterways in Maryland have recreational fish consumption guidelines for one or more species. This information is especially important for women of childbearing age and children.

- Methylmercury is common in large and small mouth bass throughout freshwaters in Maryland. There is no clear geographical trend, although several sites in western and eastern Maryland have higher values. The highest average value has been measured in Lake Lariat in Calvert County; women of childbearing age who catch and eat fish from this site are advised to eat less than one meal per month of small and large mouth bass.
- PCBs levels in white perch are higher in the northern tributaries of the Chesapeake Bay, suggesting a greater number of historical sources or persisting

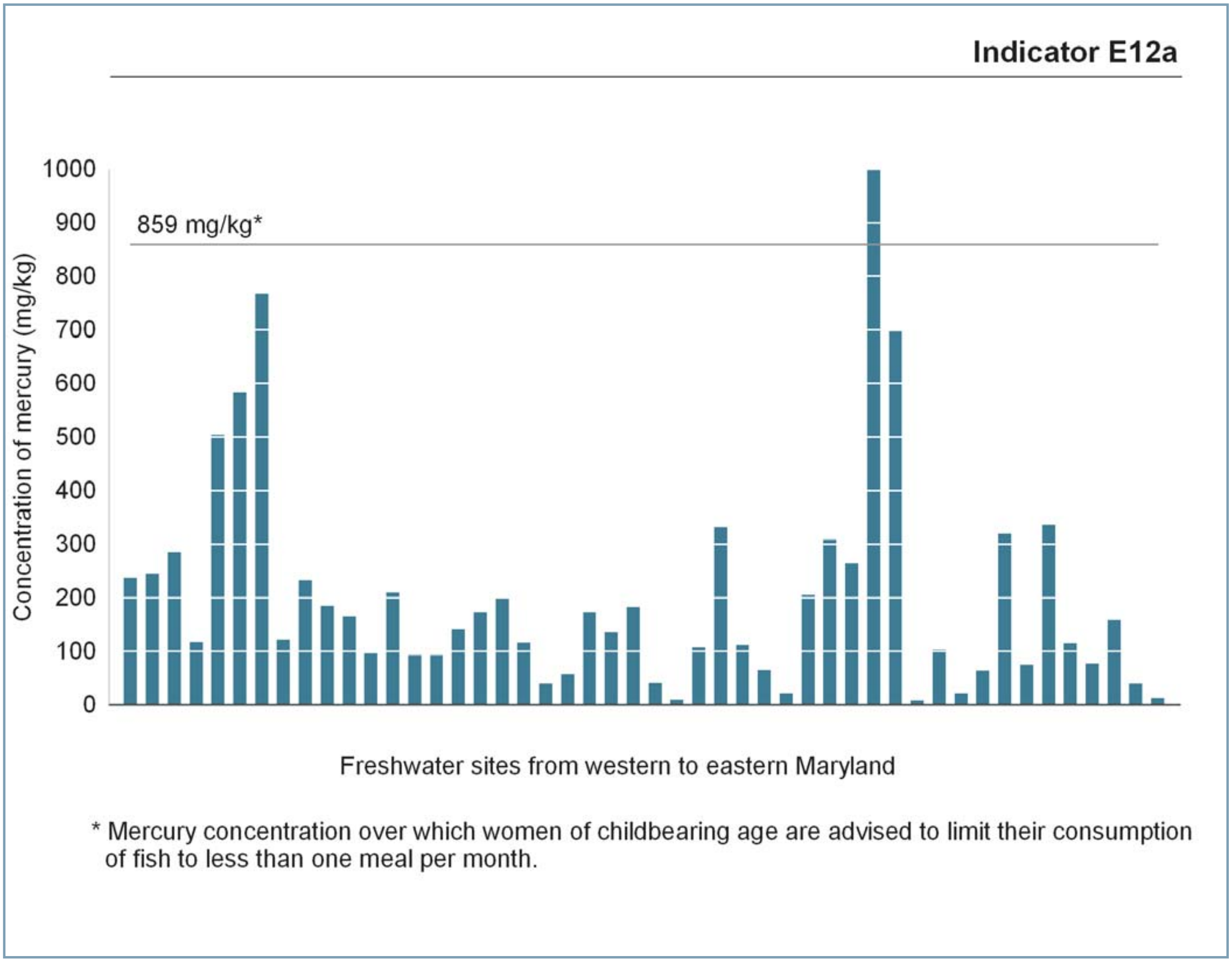

Figure 16. Average Mercury Concentrations in Black Bass from 48 Freshwater Sites in Maryland, 1999 – 2005
Source: Maryland Department of the Environment

low-level sources for this area. The highest average values occur in the Patapsco River, followed by the Elk, Middle, and Back Rivers, where women who catch and eat fish are advised to avoid eating white perch or eat less than one meal per month.

Important information about other fish species and locations is available at the MDE website.

Healthy People 2010: Objective 8-10 of Healthy People 2010 focuses on reducing the potential human exposure to persistent chemicals by decreasing fish contaminant levels.

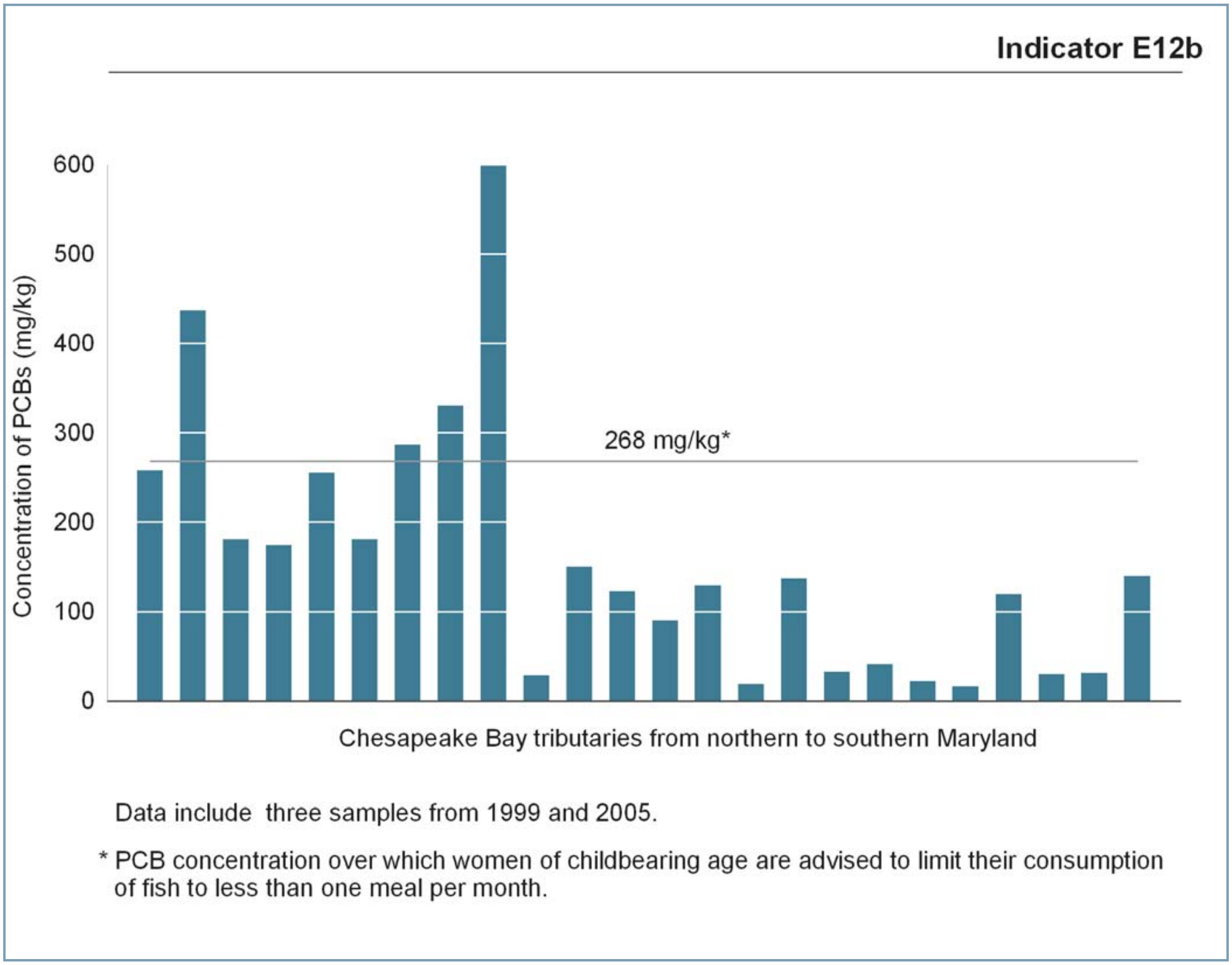

Figure 17. Average PCB Concentrations in White Perch from 24 Estuarine Sites in Maryland
Source: Maryland Department of the Environment

Part 2: Body Burden

This section describes the measurement of environmental chemicals or their metabolites in children. The measurement of chemicals in the body is called biomonitoring. Biomonitoring can be done on urine, blood, hair, nails, saliva, fat tissue, and other tissues and it is conducted to determine the "body burden" of environmental contaminants.

Biomonitoring can be useful to confirm that exposures have occurred, even if the source or dose is typically not known. In a population, biomonitoring can be used to determine reference ranges for "normal" body burdens, and to help define the body burden associated with disease (a "dose-response"). This is a complicated task because many factors other than environment influence the development of disease. Some chemicals also have a relatively rapid turnover in the body and are thus more difficult to monitor. Thus, a body burden of a certain chemical does not necessarily mean that an individual will develop a disease. However, it is generally assumed that the higher the body burden (dose), the higher the risk of developing an associated disease. This may be true for groups of children with similar exposures, but may not necessarily hold for individuals because of other unknown influences.

Interpretation of biomonitoring data should ideally be based on comparison to baseline or reference values for a comparable unexposed population. The most straightforward way to do this is with a comparison group sampled at the same time. Reference values from a general population may also be used, but these should be recent because levels of chemicals may change in the environment and in the population over time (Wilhelm et al., 2003).

There are several chemicals of concern in Maryland that lend themselves to biomonitoring; however, there is limited availability of body burden measures in children. At the national level, the CDC has incorporated body burden measures, including lead, mercury, and an increasing number of other chemicals (e.g., pesticides) into annual national surveys. Blood lead is the only measure that has been widely and regularly assessed in children and thus is the only body burden indicator that is presented in this section.

2.1 Lead in Children

Lead is a metal that has toxic effects on multiple organ systems, and is capable of causing severe health problems up to and including death. Even at low levels, childhood exposure to lead contributes to reduced intelligence and cognitive development. Studies also have found that childhood exposure to lead contributes to attention-deficit/hyperactivity disorder and hyperactivity and distractibility; an increased risk of having a reading disability, lower vocabulary and lower class standing in high school; and an increased risk for dropping out of high school, antisocial, and delinquent behavior (Bellinger, 2004; Lanphear et al., 2000; Needleman and Gatsonis, 1990). Although a blood lead level of 10 micrograms per deciliter (µg/dL) or greater may be referred to as "elevated blood lead level," there is no safe level of lead in blood. For example, declines in reading and arithmetic have been observed at blood lead levels below 5 µg/dL (Needleman and Gatsonis, 1990). Studies suggest that every 10 µg/dL increase in blood lead is associated with a 1-point to 5-point decline in IQ (Koller et al., 2004; Canfield et al., 2003). In children between the ages of one and five, lead is particularly harmful to the developing brain and nervous system (Koller et al., 2004).

In the past, outdoor air concentrations of lead from leaded gasoline were a major contributor to blood lead levels in children. In 1978, there were about three to four million children with blood lead levels greater than 10 µg/dL in the United States. By 2002, with the banning of leaded gasoline and lead-based paint, that number dropped to just over 300,000 children (EPA, 2005). Today's elevated blood lead levels are due mostly to ingestion of contaminated dust, paint, and soil. Lead is not biodegradable, therefore the gradual deterioration or renovation of properties with lead-based paint can produce contaminated dust, soil, and paint chips. Past emissions of leaded gasoline that subsequently were deposited in the soil can also end up in and around the house.

Blood lead levels are highest for younger children, who play and crawl on the ground and frequently put their hands in their mouths. Within the larger population, blood lead concentrations differ by race and family income and are useful in identifying communities that are at greatest risk. Maryland and the CDC have adopted a goal to reduce the number of new cases of elevated blood lead to zero by 2010.

B1: Percentage of Children 0 – 72 Months of Age Tested for Lead and Percentage With Blood Lead Levels ≥ 10 Micrograms Per Deciliter

Blood lead testing is mandatory practice for pediatricians serving in communities with older housing. Maryland has many such areas and requires all children who live or have lived in at-risk areas to be tested during their routine doctor visits at twelve and twenty-four months of age. Testing is also mandatory for children who are receiving Medicaid assistance. Screening questionnaires or blood lead tests are required for children entering day care.

- Testing for young children increased statewide from 13.2 percent in 1996 (59,700 children) to 22.2 percent in 2006 (103,000 children).

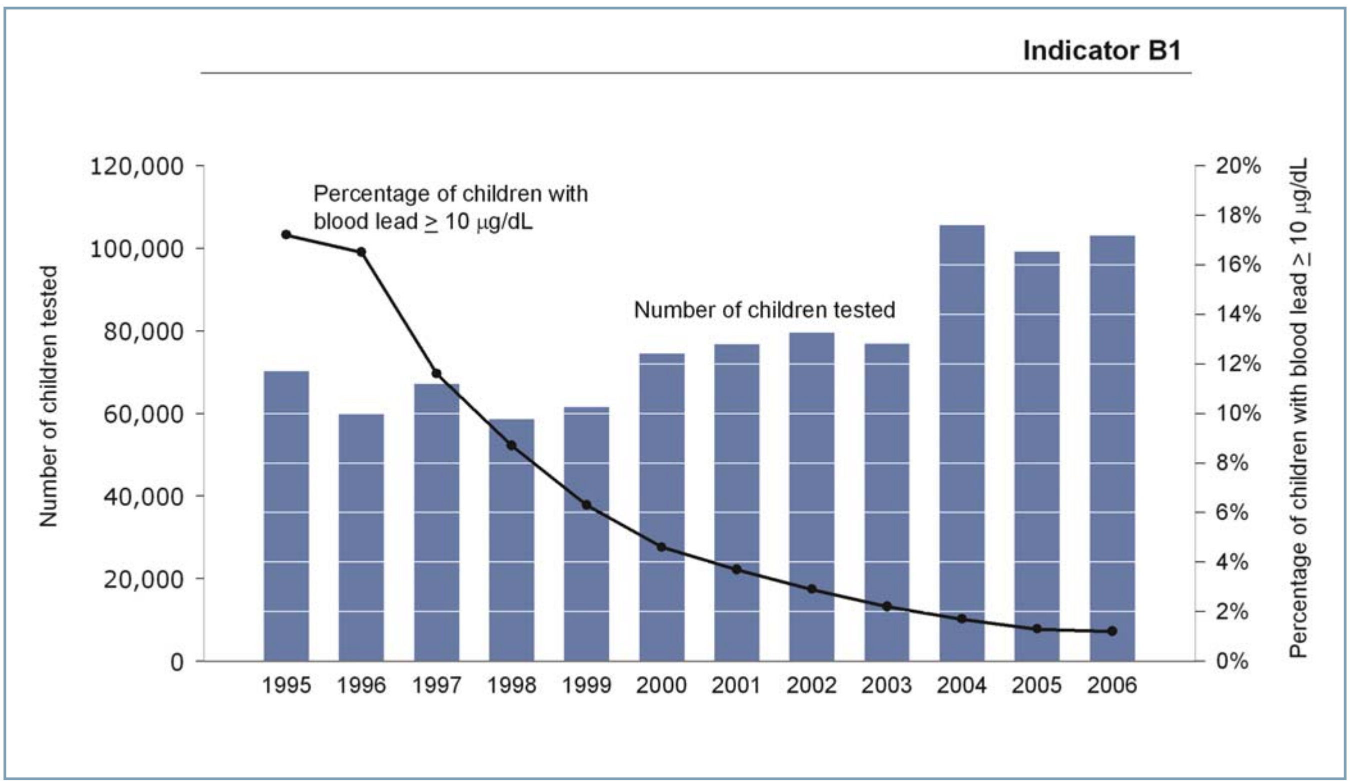

Figure 18. Trends in Blood Lead Testing and Elevated Blood Lead Levels in Maryland Children 0 – 72 months of Age, 1995 – 2006
Source: Maryland Childhood Lead Registry

- The number of children statewide with blood lead levels greater than 10 µg/dL has declined steadily from 17.2 percent in 1995 to 1.2 percent in 2006 (see Figure 18).

Healthy People 2010: Objective 8-25 of Healthy People 2010 focuses on reducing exposure of the population to pesticides, heavy metals, and other toxic chemicals, as measured by blood and urine concentrations of the substances or their metabolites (8-25c—Lead). Objective 8-27 of Healthy People 2010 focuses on increasing or maintaining the number of territories, tribes, and states and the District of Columbia that monitor diseases or conditions that can be caused by exposure to environmental hazards (8-27a—Lead Poisoning). Maryland Health Improvement Plan 2000 – 2010: Child and Adolescent Health—Focus Area 2 focuses on Preventing Childhood Lead Poisoning.

B2: Distribution of Concentrations of Lead in the Blood of Children 0 – 72 Months

The CDC's recommended action level, the trigger for initiating case management and individual care of children, dropped from 60 µg/dL in the 1970s to 10 µg/dL in 1991 as more information came to light concerning the adverse effects of lead. The case management of children uses a multi-layered approach, which varies slightly between jurisdictions. Typically, at 10 µg/dL, steps are taken to educate the parents, notify the property owner, and confirm the blood lead results. At 15 µg/dL, an environmental sanitarian conducts an investigation and landlords are required to fix the property, if warranted. At 20 µg/dL, a complete medical evaluation is added, including a developmental and psychological evaluation. Special medical treatment to reduce blood lead levels is considered at this stage.

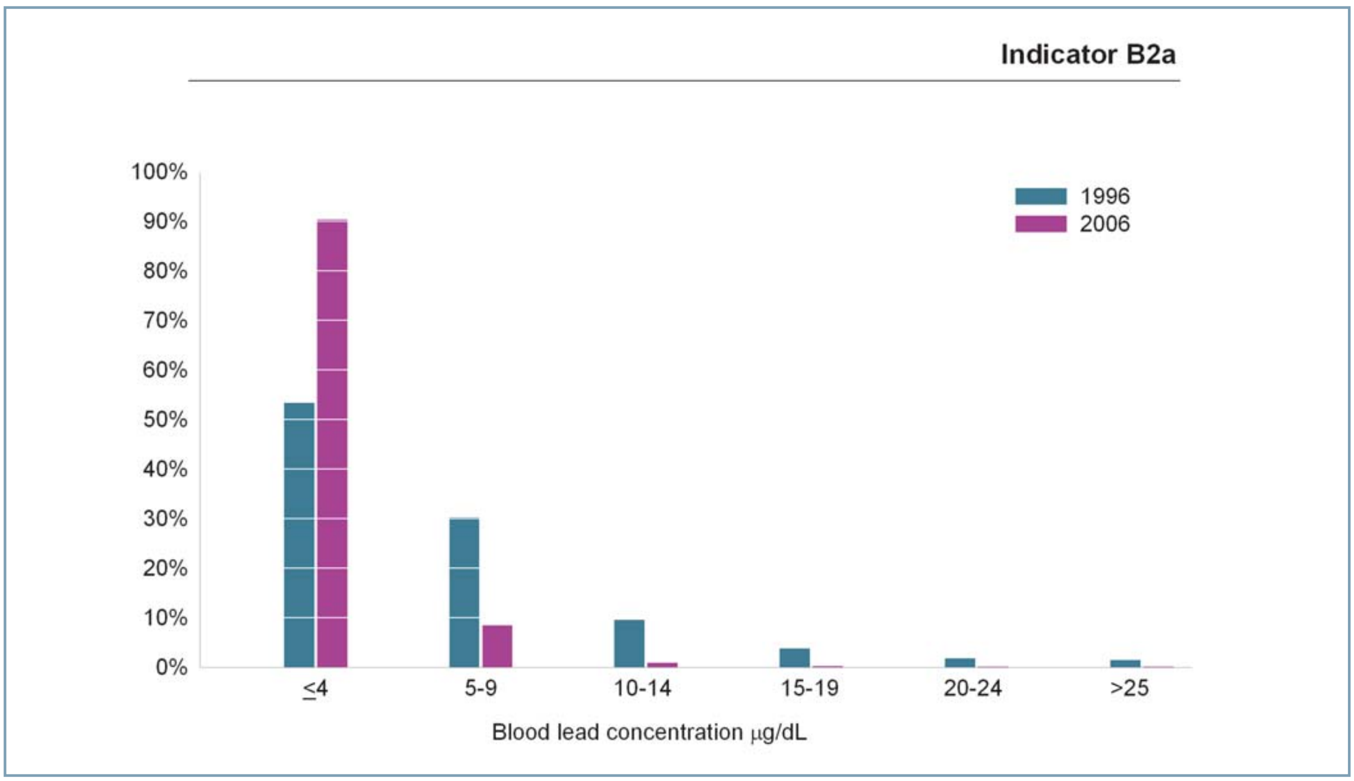

Figure 19. Percentage of Children 0 – 72 Months of Age by Blood Lead Level, 1996 and 2006
Source: Maryland Childhood Lead Registry

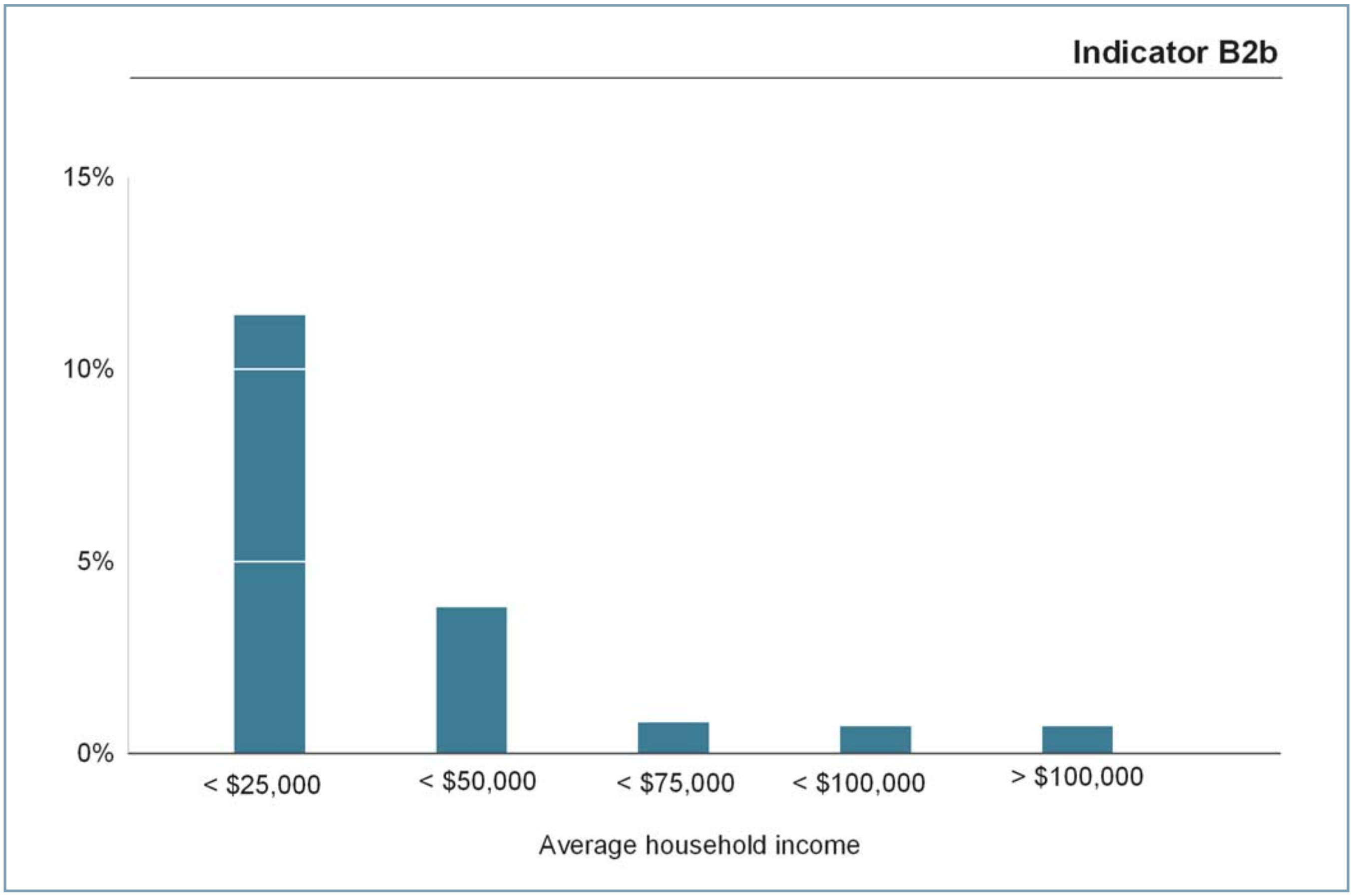

Figure 20. Percentage of Children 0 – 72 Months with Blood Lead Levels ≥ 10 µg/dL, by Household Income, 2002 – 2004
Source: Maryland Childhood Lead Registry. Average household incomes are based on the Census tract of residence, using U.S. Census 2000.

Blood lead levels in children in Maryland are shown in Figure 19. The time period allowed for medical care narrows to a matter of few days as blood lead levels increase beyond 45 µg/dL.

Figures 20 and 21 show the percentage of children 0 – 72 months of age with blood lead greater than 10 µg/dL by household income and location.

- Among children tested for lead statewide, the percentage of children with blood lead levels at the lower end of the spectrum (≤ 4 µg/dL) increased from 53.4 percent in 1996 to 90.4 percent in 2006. During the same time period, the percentage of children with lead "poisoning," defined as a blood lead level greater than 20 µg/dL, decreased from 1.8 percent to 0.1 percent.
- Most instances of blood lead greater than 10 µg/dL occur in families with annual incomes below $25,000.

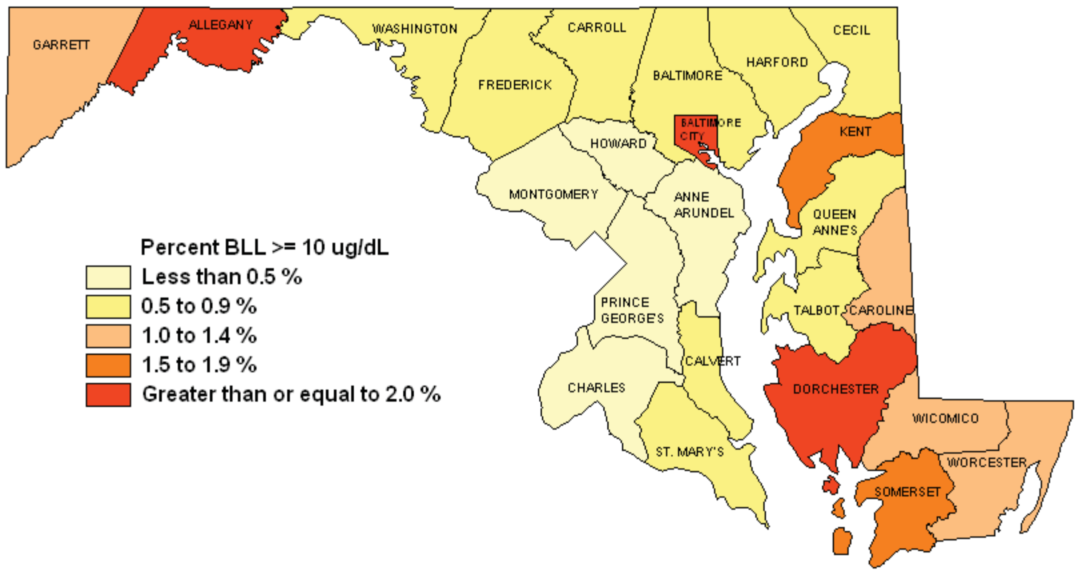

Figure 21. Percent of Children 0 – 72 Months Tested for Lead with Blood Lead Levels >=10 μg/dL, 2004 – 2006

Source: Maryland Department of the Environment, Lead Poisoning Prevention Program: Childhood Lead Registry

- The jurisdictions with the highest percentage of children with blood lead levels (greater than 10 μg/dL) are Baltimore City, Dorchester and Allegany Counties. Relatively high rates of elevated blood lead levels also occur in counties on the Eastern Shore and in far western Maryland.

Healthy People 2010: Objective 8-25 of Healthy People 2010 focuses on reducing exposure of the population to pesticides, heavy metals, and other toxic chemicals, as measured by blood and urine concentrations of the substances or their metabolites (8-25c—Lead). Maryland Health Improvement Plan 2000 – 2010: Child and Adolescent Health—Focus Area 2: Preventing Childhood Lead Poisoning.

Part 3: Childhood Illnesses

Children's environmental health is ultimately concerned with the health of children, and the environmental factors thought to affect health. This section describes some of the childhood conditions for which environmental factors are thought to contribute in part to the occurrence or aggravation of the condition. The concern is that children will be exposed and adversely affected by exposures to environmental agents that produce diseases or conditions in the short term or in the future. These effects may be grossly obvious or subtle; they may be clearly associated with an exposure or only speculatively. The relationship of a given exposure and health outcome in children may be inferred from studies in animals or adult humans or through epidemiologic studies based on temporal and spatial occurrence of cases.

The proportion of the condition that is attributable to environmental factors (termed the "attributable risk") may be unclear for the population as a whole, and is usually unknown for the individual child. The diseases and disorders discussed here include respiratory diseases, cancer, and neurodevelopmental conditions. These topics are included because there is a significant body of knowledge suggesting a link between environmental exposures and disease and because there is an available data source to describe the occurrence of the conditions over time in Maryland.

3.1 Respiratory Diseases in Children

Respiratory diseases are common in childhood. They frequently may interfere with a child's normal activity, including school attendance and performance. These conditions may be acute, such as infections, or chronic, such as asthma. They may be mild or associated with childhood deaths. Both acute and chronic respiratory conditions may be caused or aggravated by environmental factors. Respiratory diseases included in this report as indicators of children's environmental health include measures of the occurrence of asthma and measures of the morbidity associated with asthma and respiratory infections.

Asthma is a chronic disease of the lungs characterized by narrowing of air passages due to inflammation, mucous production, and abnormal spasms of small airways. The shortness of breath, cough, and wheezing associated with asthma may be intermittent or persistent. Exacerbations of asthma often require visits to the health care provider, emergency department, or hospital. Asthma is treated primarily by inhaled or oral medicines that help open the air passages and prevent the narrowing of the lung passages.

Several environmental agents have been linked to asthma exacerbations. Indoor environmental agents that are associated with asthma exacerbations include pet dander, mold, second-hand smoke, cockroaches, cold viruses, and dust mites. Air pollutants, including ozone and particulate matter, pollen, and changes in weather are factors in the outdoor environment that have been linked to asthma exacerbations. There is some research that suggests that early exposures to air pollution, allergens, and tobacco smoke may cause asthma.

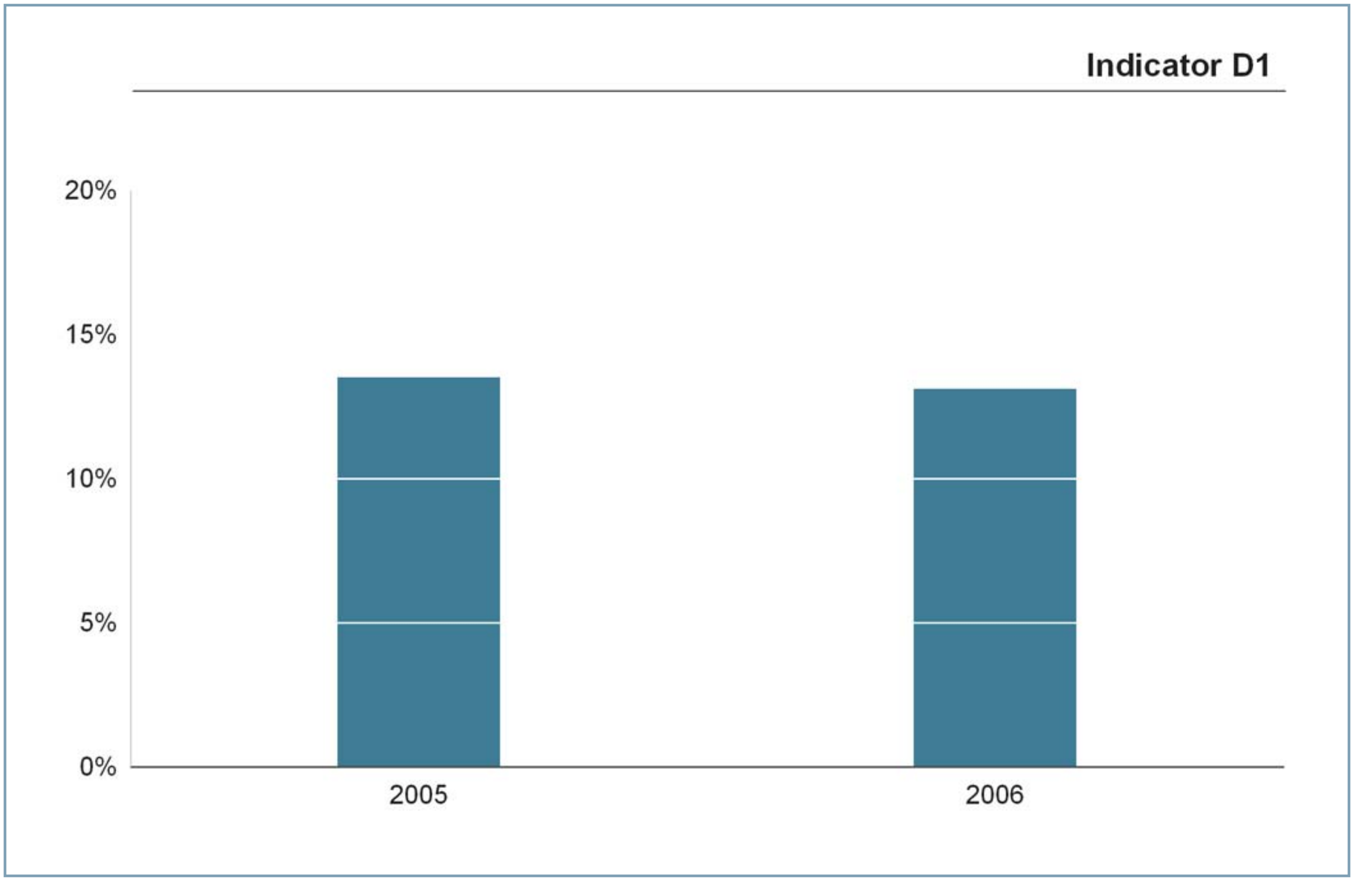

Figure 22. Percentage of Children with Asthma, 2005 – 2006
Source: Maryland Department of Health and Mental Hygiene

D1: Percentage of Children Less Than 18 Years of Age with Asthma

Asthma is the most common cause of chronic childhood illness and affects 6.4 million children in the United States (CDC, 2002). There are large social and economic costs for childhood asthma, including $3 billion a year in healthcare costs (Mellon and Parasuraman, 2004). Although genetic influences are thought to cause some cases of asthma, there is limited evidence for other causes. The prevalence of asthma in children in the United States has been increasing over the last several decades. U.S. data from 1982 – 1992 demonstrated an increase in the prevalence of asthma from 34.7 per 1,000 population to 49.9 per 1,000 population, which is a 42 percent increase (Akinbami, 2006; Vollmer et al., 1998). When rates of a condition change over relatively short periods of time, an external factor, such as environmental exposure, may be implicated in this change.

- As shown in Figure 22, the percentage of Maryland children with asthma is approximately 13 percent for 2005 – 2006 (the only dates for which data are available for the prevalence of asthma in Maryland's children).
- Black children are more likely to be affected than other children (data not shown).

D2: Rate of Children's Emergency Department Visits and Hospitalizations for Asthma and Other Respiratory Causes

Although many respiratory illnesses can be managed with outpatient treatment, these conditions may result in the need for emergency care and hospitalizations if improperly managed. Multiple factors are associated with these severe events, including environmental factors, access to primary healthcare, and medical management. The precise diagnosis of a respiratory condition in a very young child is frequently difficult such that what appears to be a respiratory infection may later be determined to have been an early asthma episode. Alternatively, in a child with asthma, an infection may precipitate an asthma attack at the same time a child may have an environmental exposure. Thus, assessments of asthma and other respiratory diseases are imperfect measures of child health.

Asthma prevalence and measures of severity are not homogeneous in the childhood population. Minority and urban children are more severely affected and the youngest children have the highest rates of emergency department visits and hospitalization. The same can be seen for other acute respiratory disease. Environmental

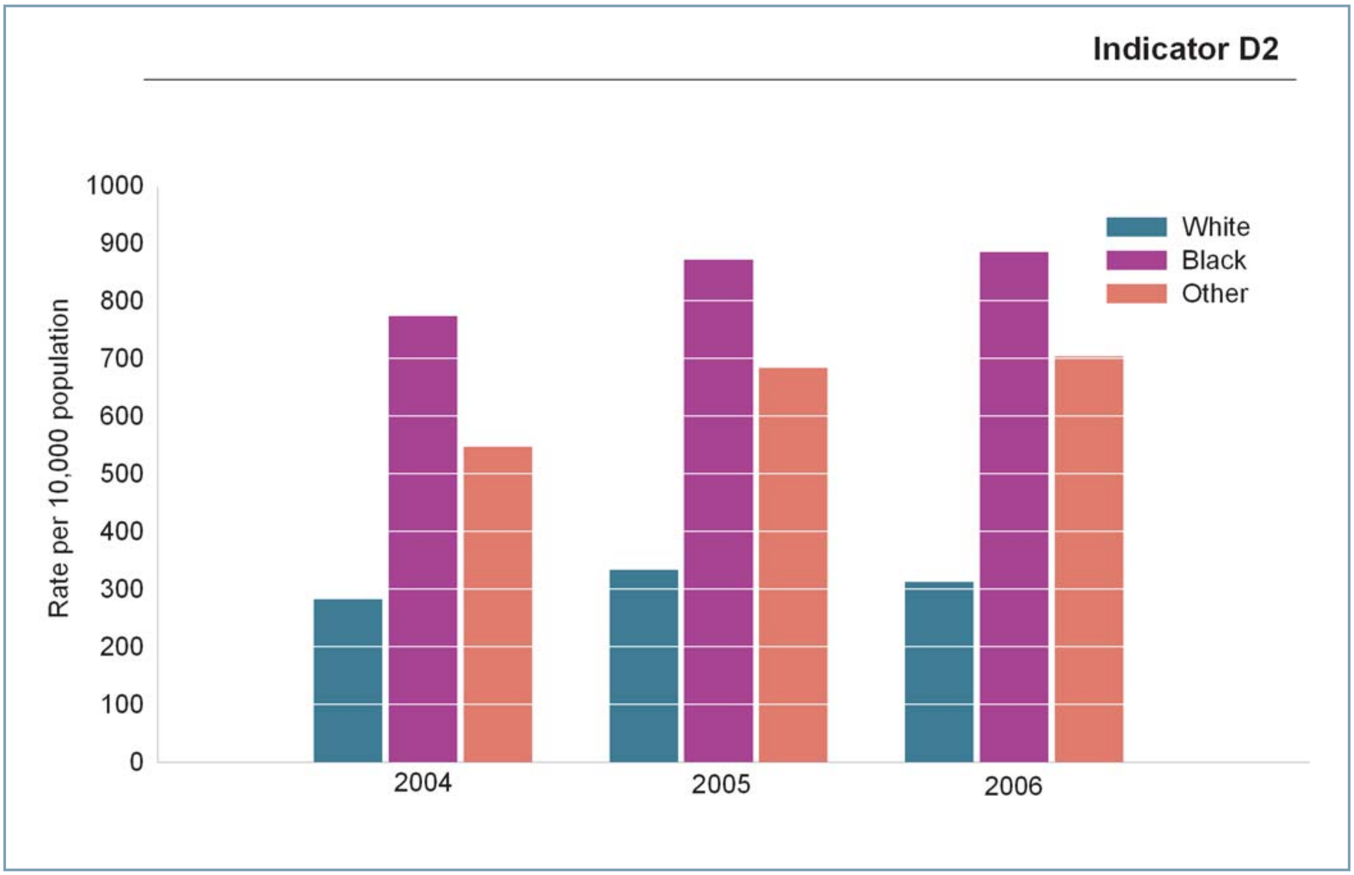

Figure 23. Emergency Department Visits for Maryland Children for Upper Respiratory Infections, 2004 – 2006

Source: HSCRC Ambulatory Care Files, 2004 – 2006, MDP Population Estimates, 2004 – 2006

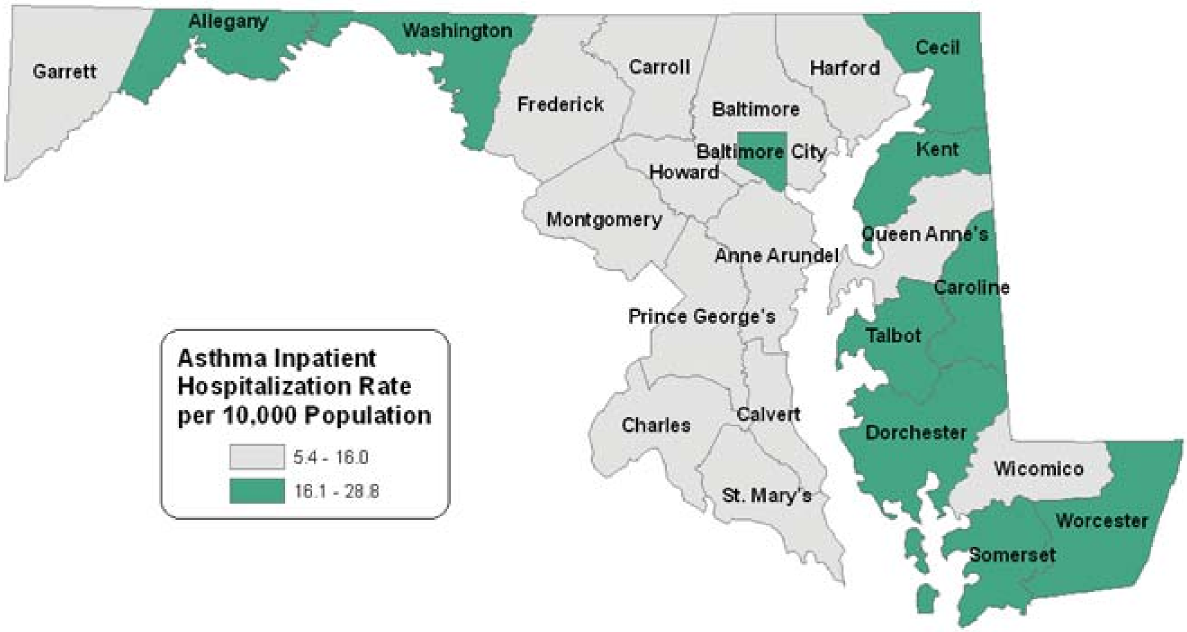

Figure 24. Hospitalization Rates for White Children Under 18 by County, 2003 – 2005
Source: Maryland HSCRC, analyzed by Center for Maternal and Child Health

factors contributing to respiratory disease may be more prevalent in urban and minority communities. Other factors leading to these disparities, such as access to healthcare, also need to be considered. Because of the potential of confounding of the diagnosis of asthma with other respiratory conditions, a combined measure (asthma and other respiratory conditions) is used to track emergency department (ED) visits over time and among populations (see Figure 23).

Figures 24 and 25 show the differences between rates of hospitalization for asthma in white and black children in the period 2003 – 2005.

- There has been a general upward trend for ED visits for upper respiratory conditions in the last three years.
- Black children are more likely than White children to be brought to the ED because of asthma or other respiratory diseases.

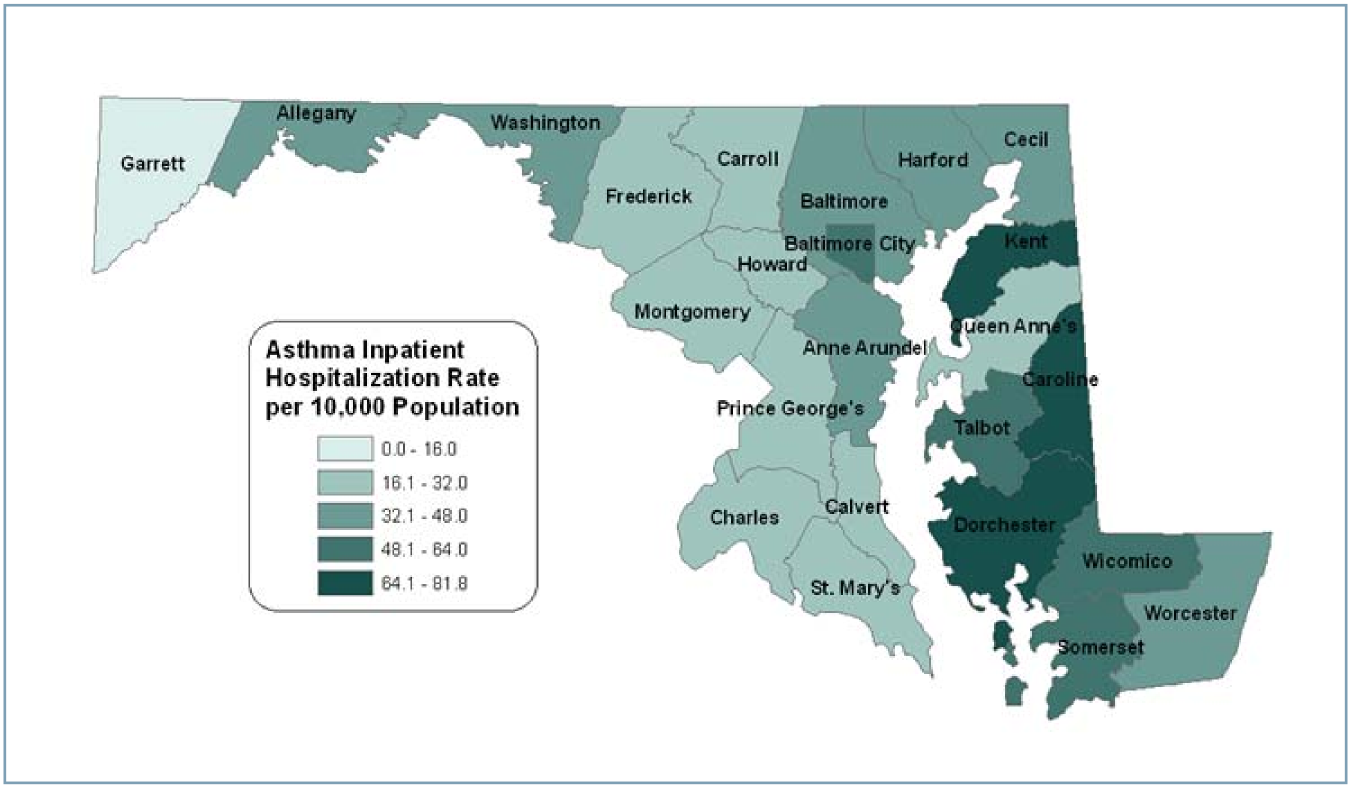

Figure 25. Hospitalization Rates for African-American Children Under 18 by County, 2003 – 2005.
Source: Maryland HSCRC, analyzed by Center for Maternal and Child Health

- Other races, including Asians and Native Americans, have witnessed the most drastic increase in ED visits.
- Hospitalization rates for asthma are higher among African Americans than Whites.
- Hospitalization rates for asthma are highest on the Eastern Shore for both Whites and African Americans.
- The rate of emergency visits for asthma is twice as high for Baltimore City as for any other jurisdiction (data not shown).

Healthy People 2010: Objective 24-2a of Healthy People 2010 is to reduce the hospitalization rate for asthma in children under age five years to 25 per 10,000; objective 24-2b is to reduce the hospitalization rate for children and adults aged five to sixty-four years to 7.7/10,000.

3.2 Childhood Cancer

Although cancer is quite rare in children, it is the second leading cause of death in Maryland among children ages 0 – 14 years, behind unintentional injuries/accidents (DHMH, 2006). Data on cancer and cancer mortality in Maryland citizens is collected and analyzed by the Maryland Cancer Registry. The standard age group included for comparisons is children less than twenty years of age, shown in the indicator below. The indicators below examine the incidence and mortality from cancer within areas of the state as well as by population groups.

The relationship between cancer and the environment is very complex. There are a few cancers that are only caused by environmental factors (mesothelioma and asbestos, for example). There are other cancers where the link to environmental factors is very strong, but multiple factors contribute to the cancer (lung cancer and tobacco smoke, for example). In still other cases, the relationship between the cancer and environmental agents is suggestive, but there is limited evidence to confirm it, or the link may be very weak, so that the environmental agent could be a minor contributing factor among many others.

The indicators presented in this section include overall childhood cancer incidence and mortality by year, region, race, and type of cancer. The cause of childhood cancers is in many cases even less well understood than for adult cancer. Certain risk factors that increase susceptibility to the development of cancers include family history, non-inherited mutations, ionizing radiation, and chemotherapeutic agents. Environmental exposures have been proposed as well, although exact causal relationships have not been established for most cancers. Environmental exposures that have been the focus of research include pesticides, organic chemicals, magnetic fields, arsenic and radiation.

D3: Overall Cancer Incidence and Mortality for Children Less Than Age Twenty

Cancer in children varies in incidence, type, severity, and mortality from adult cancers. Nationwide, the childhood cancer mortality rate for children less than twenty years of age is less than 30 per 1,000,000 (Ries et al., 2008). However, it is estimated that about 100,000 children less than fifteen years of age will be diagnosed each year with some type of cancer. Childhood cancer survival rates have shown improvements during the past twenty years primarily due to advancements in technology, diagnosis, and treatment. The current five-year survival rate is greater than 75 percent (Ries et al., 2007).

Gender and age differentials exist nationally and statewide. Male children in Maryland have a higher incidence rate than females (156.6 per one million vs. 140 per one million). Males also have a higher mortality rate and count due to the fact that they experience more cancers. Nationally, the age trend of cancer incidence and mortality begins with a high rate in the birth to age four group at 189 per million, then declines to 96.8 per one million in the five- to nine-year age group, but then steadily rises in the next age grouping and peaks again in the fifteen- to nineteen-year age group at 200 per one million. The same holds true for the mortality rate in Maryland.

Figure 26 shows overall cancer incidence and mortality (all types of cancer) for children in Maryland. Figures 27 and 28 show the breakdown by geographic region and race (again for all types of cancer).

- Overall cancer incidence and mortality rates have been relatively constant since 1992. (Note: The decrease in 2001 appears to be transient, and may be related in part to incidence reporting. More

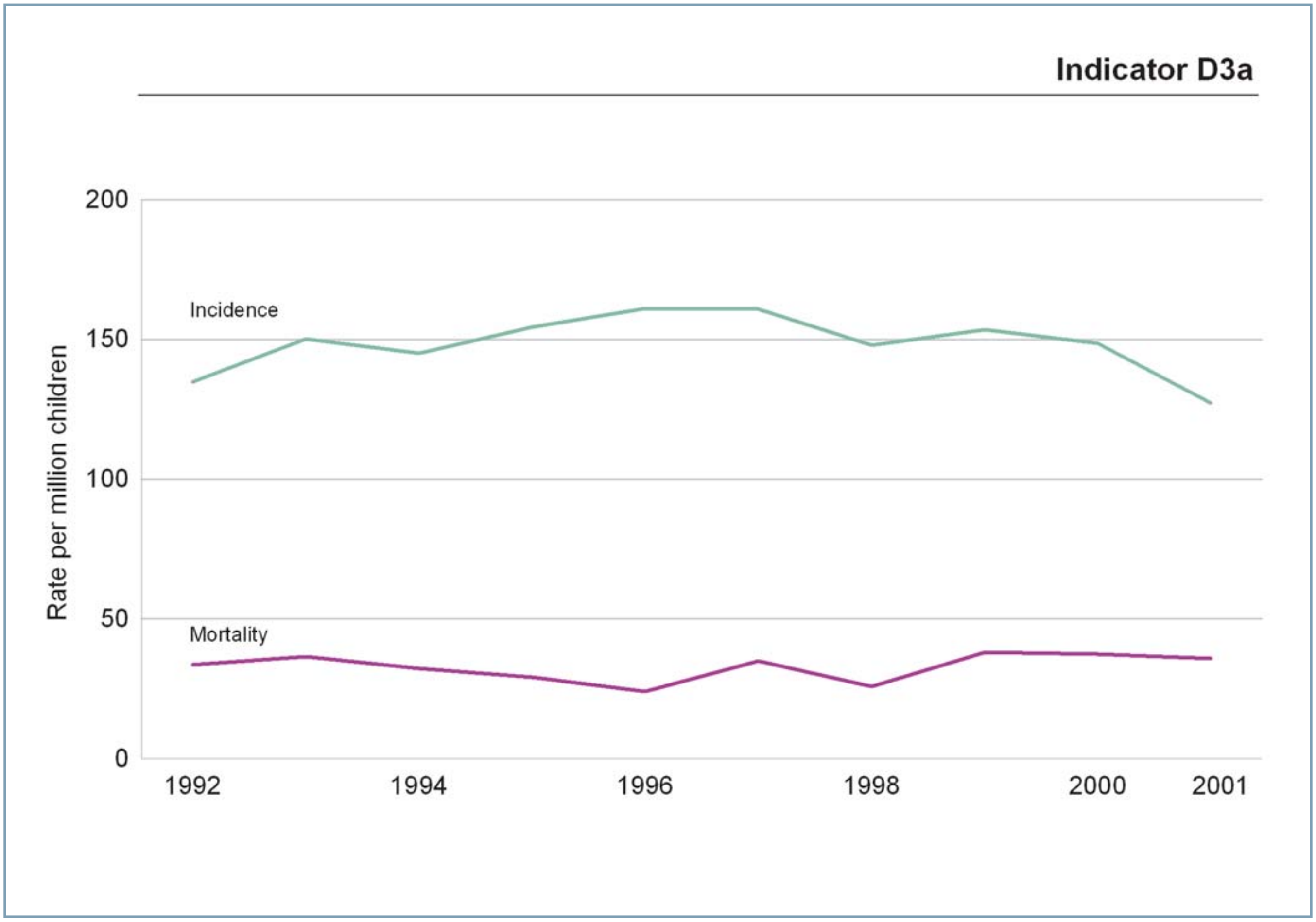

Figure 26. Childhood Cancer Rates in Maryland, 1999 – 2001
Source: Maryland Cancer Registry

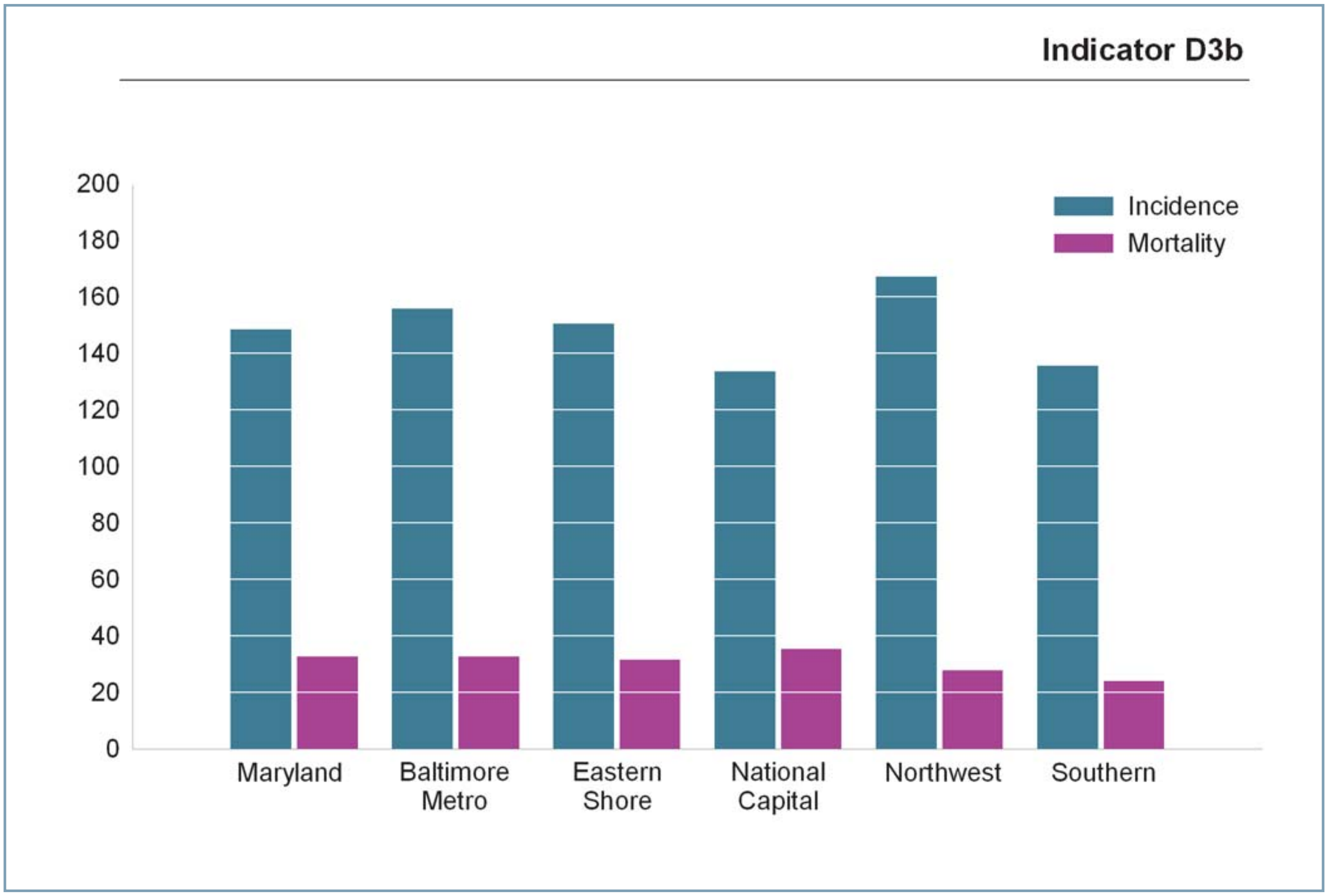

Figure 27. Childhood Cancer Rates by Region, 1992 – 2001
Source: Maryland Cancer Registry

recent data from 2002 and 2003, (not shown) demonstrate that the incidence rate continues to be around 150 per million (source: Maryland Cancer Registry)).

- The cancer incidence rate continues to substantially exceed the mortality rate, meaning most individuals diagnosed with cancer survive.
- There are modest differences in cancer rates between the regions of Maryland. The Northwest region had the highest incidence rate of 167.2 per one million, followed by Baltimore Metro (155.9 per one million), Eastern Shore (150.6 per one million), Southern (135.7 per one million), and National Capital (133.5 per one million).
- Mortality rate was highest in the National Capital region; however, the mortality rate is relatively close between each region.

Indicator D3c

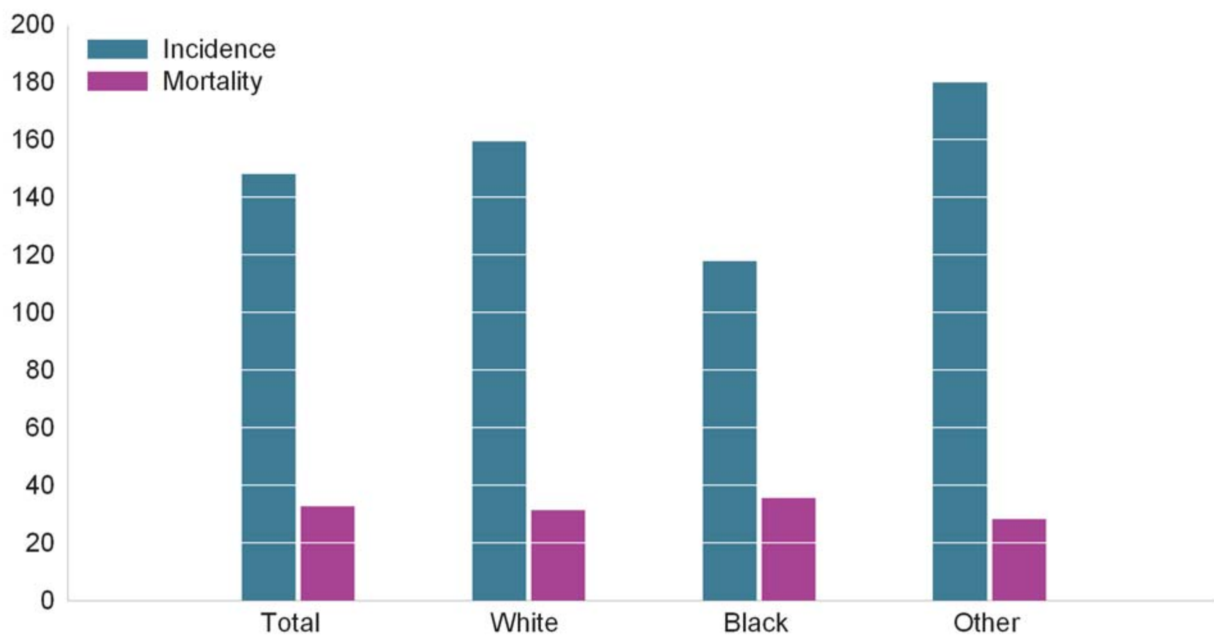

Figure 28. Childhood Cancer Rates by Race, 1992 – 2001
Source: Maryland Cancer Registry

- Whites had a higher incidence rate (159.3 per one million) than Blacks (117.9 per one million), but were less than the "Other" category, including Asians and Native Americans, (180.4 per one million).
- Blacks experienced a slightly greater mortality rate of 35.5 per one million compared to Whites of 31.3 per one million.

3.3 Neurodevelopmental Disorders

Beginning *in utero* and extending through early childhood, children have rapidly developing brains and nervous systems and, as such, are particularly vulnerable to disruption of normal development. Children's neurobehavioral development is a complex interplay of biologic potential and social and environmental factors both positive and negative. Genetic and environmental factors may interact, producing widely different outcomes in individuals with similar exposures. Children with already vulnerable nervous systems may be more seriously affected than their peers.

The effects of hazardous exposures are most often examined at high doses in laboratory animals and acute accidental exposures in humans. However, concerns exist that health effects are present and may be significant at low level and chronic exposure. These relationships are much more difficult to detect. In addition, toxicants may have an additive or synergistic effect when multiple related exposures occur.

The most commonly recognized children's environmental neurotoxin is lead. Lead has a direct and significant impact on the neurodevelopmental outcomes of children. Children most often manifest the effect of lead on their nervous system with learning or behavioral problems or decreased intelligence quotient (IQ). However, the neurodevelopmental expression of lead poisoning is such that it can easily be attributed to other factors in the absence of a correlated blood lead level. Other metals in children's environments, such as mercury and manganese, have also been suggested as potential behavioral neurotoxins, but because there is little biological monitoring and exposure information, and because epidemiological study results have varied, there is an absence of consistent exposure-dose-effect information.

Concerns regarding other pollutants in the environment are based on observations of children as well as from studies in animals that demonstrate neurodevelopmental abnormalities. Some chemicals in the environment known to affect the nervous system include PCBs, other pesticides, and polybrominated biphenyl ethers (PBDEs—flame retardants). Concerns have also been raised about neurodevelopmental conditions such as attention deficit disorder (ADD) and autism, but there is insufficient evidence to point to any particular environmental exposure. Other explanations also may exist, such as changes in diagnostic criteria or intensified identification.

D4: Rate of Neurodevelopmental Disorders Among Children 6 – 11 Years Old

Because of the reasons mentioned above, it is difficult to determine an optimal indicator of environmental effects on children. In EPA's national report (EPA, 2003), parental reporting of Mental Retardation from CDC's National Health Interview Survey was chosen as an indicator of neurodevelopmental disturbance. This information is not available at the state level. This metric also exhibits several problems. Mental retardation is a late and severe neurodevelopmental finding. There are many potential causes, with fetal alcohol exposure being the most common known cause. However, the etiology of most cases is unknown. The EPA report also discussed ADD as an emerging area of concern.

For this report, the Maryland State Department of Education (MSDE), Special Education Child Count data were selected to reflect the burden of neurodevelopmental disorders in the child population. MSDE compiles information concerning children's primary disability as identified under the Individuals with Disabilities Education Act (IDEA). The data are of high quality and available over a multi-year time period. The classification of educational disability conforms to national definitions and can be examined in a format similar to the national sample. It should be stressed that these data do not reflect the cause of the educational disability, nor do they reflect children's

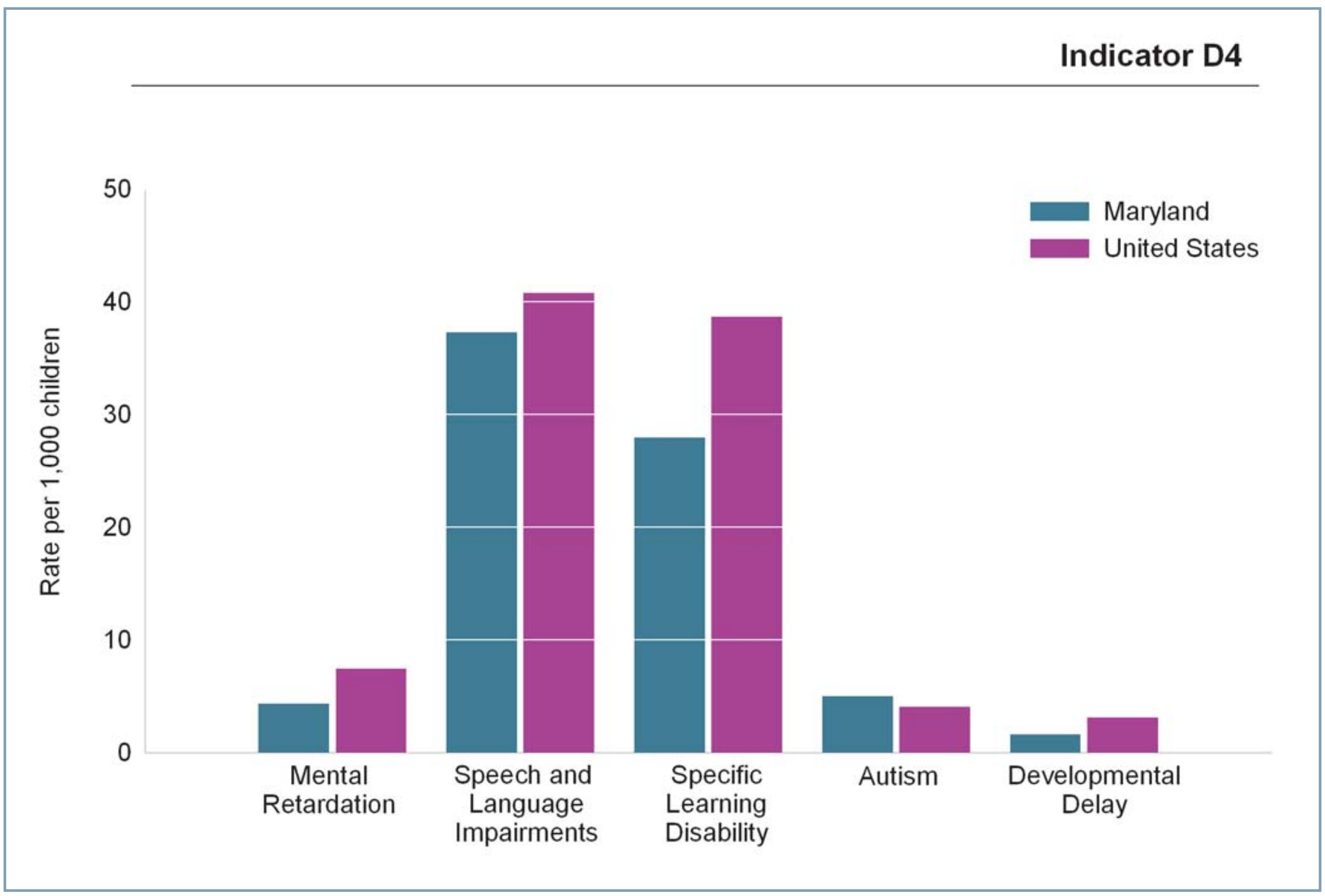

Figure 29. Students Ages 6 – 11 Years Old with Neurodevelopmental Disorders, 2004
Source: Maryland State Department of Education

total neurodevelopmental status. However, we believe that this is the best data source currently available in Maryland that looks at children across the state with neurodevelopmental issues, an unknown portion of which may be attributed to environmental exposures. For this indicator, children ages six to eleven years are used because this is an age group where children are most likely to be included in the state data set. Census figures, instead of enrollment data, are used to determine rates of occurrence since children who are not enrolled in public school are also included in the data. See Figure 29 for state and national levels of neurodevelopmental disorders. Data from a subset of children with conditions that are more likely to have a proportion attributable to environmental etiologies and for which there may be some diagnostic overlap are utilized as an indicator of neurodevelopmental disorders. This subset of conditions is referred to as the "neurodevelopmental subset," and includes mental retardation, developmental delay, speech and language impairment, specific learning disability, and autism.

- The overall rate of neurodevelopment problems remained consistent from 2001 to 2004.
- Speech and Language Impairments, as well as Specific Learning Disabilities, have slightly declined since 2001; however, they continue to be the most common neurodevelopment classification for children in Maryland.
- Autism increased slightly between 2001 and 2004 and remains as common as mental retardation.

3.4 Pesticide-Related Illnesses

This section describes illnesses that result from exposure to pesticides. Pesticide hazards and exposures are described in Section 3.4.

D5: Emergency Department Visits for Acute Pesticide Exposure

Children brought to the emergency department for concerns regarding pesticide exposure (see Figure 30) are generally those in which a poison center or caregivers have a more serious concern. For each year, the majority of visits (64 – 81 percent) were coded as being related to unclassified pesticides or mixtures of insecticides. The next most common type of pesticide specified were disinfectants (13 – 19 percent). These events are relatively infrequent but can be looked at over time and in different population groups.

- African American children are more likely than White children to be brought to the emergency department because of pesticide exposure. The racial variation in emergency department utilization may relate to health care access issues or increased incidence of acute pesticide exposure.
- Rates of ED visits due to pesticide exposure are also higher among children of other races compared to White children.

Healthy People 2010: Objective 8-13 of Healthy People 2010 focuses on reducing pesticide exposures that result in visits to a health care facility.

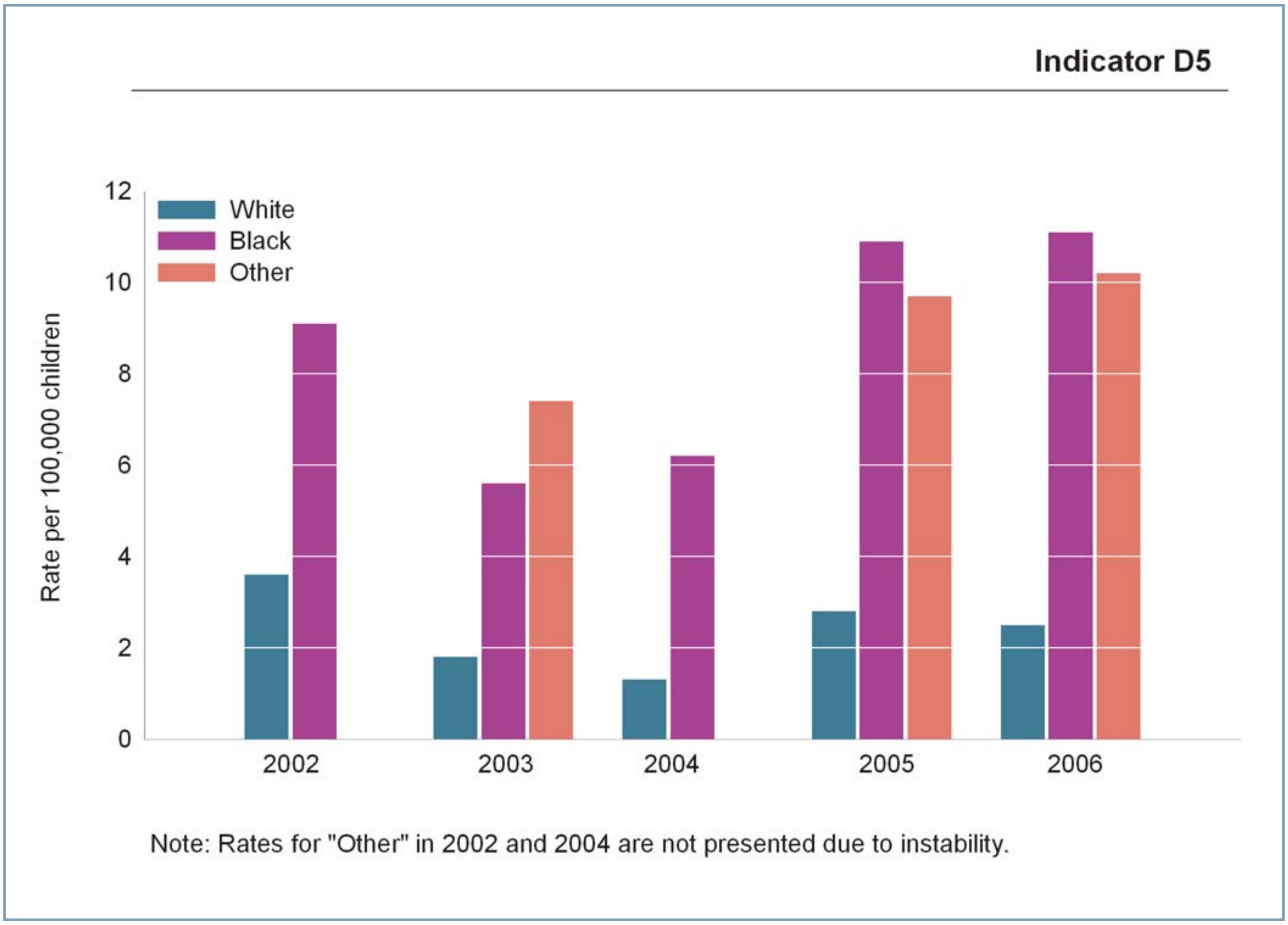

Figure 30. Emergency Department Visits for Maryland Children Due to Pesticide-related Illness or Injury, 2002 – 2006

Source: HSCRC Ambulatory Care Data, USA Population Data (2002 – 2005). MDP Population Estimages (2006).

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Introduction

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Appendix A: An Overview of Maryland's Children

Like the U.S. population overall, children constitute 26 percent of Maryland's population (Table A-1). Compared to the U.S., a greater proportion of Maryland's population is Black, and much of this and other minority populations are concentrated in and around inner cities, especially Baltimore.

There has been a gradual decrease in the number and rate of infant deaths over the past decade in Maryland. As data from 1995 – 2002 show (Table A-2), the Maryland infant mortality has consistently been higher than that of the United States. Mirroring national statistics, there is an enduring racial disparity between Black non-Hispanic and White non-Hispanic infant mortality rates in Maryland. A Black non-Hispanic baby in Maryland was nearly three times as likely to die before age one than a White non-Hispanic baby. The jurisdictions with the highest infant mortality rates from 2000 – 2005 were Baltimore City and Somerset County. Western Maryland, Prince George's County and other counties of the Eastern Shore also demonstrated a relatively higher infant mortality rate.

Low birth weight is one of the leading causes of infant mortality. In addition, infants born with low birth weight (less than 5 pounds, 8 ounces at birth or 2,500 g) have a higher probability of experiencing developmental delays. In contrast to the decline in infant mortality in Maryland, the rate of low birth weight has slowly increased during the past decade, from 8.5 percent in

Table A-1. Maryland's General Population vs. the US Population in 2000

	Maryland	United States
Total Population	5,296,486	281,421,906
Children (under 18 years)	26%	26%
Racial sub-groups*		
White	60%	71%
Black	33%	16%
Asian and Pacific Islander	4%	4%
Native American	Less than 1%	1%
Other race	2%	8%

*Population of one race alone
Source: US Census Bureau, 2000

Table A-2. Infant Mortality Rate by Race/Ethnicicty, Maryland and the US, 2004

	Maryland	United States
Total	8.2	6.8
Black, Non-Hispanic	14.5	13.6
Native American	*	8.4
White, Non-Hispanic	5.0	5.7
Hispanic	5.4	5.5
Asian/Pacific Islander	5.1	4.7

*Data do not meet standard or reliability of precision; based on fewer than 20 deaths in the numerator.
Source: Maryland Department of Health and Mental Hygiene, Vital Statistics Administration, U.S. Centers for Disease Control and Prevention, National Vital Statistics System, CDC, 2005a

Table A-3. Percentage of Low Birth Weight (<2,500g) Births by Race/Ethnicity, Maryland, 2004

	% Low Birth Weight (<2.500g)	
	Maryland	United States
Total (all races/ethnicities)	9.4	8.1
Black, Non-Hispanic	13.2	13.7
White, Non-Hispanic	7.5	7.2
Native American	8.6	7.5
Asian/Pacific Islander	8.0	7.9
Hispanic	7.3	6.8

Sources: Maryland Department of Health and Mental Hygiene, Vital Statistics Administration, U.S. Centers for Disease Control and Prevention, National Vital Statistics System (CDC, 2005b)

1995 to 9.4 percent in 2004. Nationally, the rate of low birth weight is also gradually increasing, from 7.3 percent in 1995 to 8.1 percent in 2004. As shown on Table A-3, in both the state and the nation in 2004, a higher percentage of low birth weight births occurred in the African American population. Low birth weight associated with premature delivery is the leading cause of death for African American babies. The percentage of low birth weight infants is highest in Baltimore City, Prince George's County and the lower Eastern Shore.

Another crucial vital statistic for children is the number of childhood deaths. The most common causes of death in children and adolescents are frequently related to preventable factors (see Table A-4). The number and rate of child deaths in Maryland decreased throughout the 1990s. In 2004 (the latest year for which national data are available), the overall mortality rate for children in Maryland ages one through four years was comparable to the national rate (30.8 per 100,000 versus 29.9 per 100,000). The mortality rate for Maryland teenagers (ages fifteen through nineteen) was also similar to the national average (66.7 per 100,000 vs. 66.1 per 100,000). There were significant differences by race and gender; Black and male children were at an increased risk of dying from all causes.

Three important descriptors of Maryland's children are economic security, education, and language and cultural barriers. Economic security can be linked to the poverty rate, the percentage of home ownership, and access to health care. Education shapes the personal growth and life chances of children, as well as the economic and social progress of the nation. Language and cultural barriers may indicate that children need additional help at school and parents who have difficulty speaking English may not be aware of resources available to them to protect their children's health (e.g., health care and advice about how to prevent disease) and to reduce exposure to environmental contaminants.

Table A-4. Leading Causes of Death for Children by Age Group, Maryland, 2003 – 2005

Rank		Age Group			
		1 – 4 Years	5 – 9 Years	10 – 14 Years	15 – 17 Years
1		Unintentional Injury	Unintentional Injury	Unintentional Injury	Unintentional Injury
	Number of Deaths (%)	54 (23.1)	59 (37.6)	67 (29.9)	154 (39.1)
2		Malignant Neoplasms	Malignant Neoplasms	Malignant Neoplasms	Homicide
	Number of Deaths (%)	28 (12.0)	29 (18.5)	37 (16.5)	103 (26.1)
3		Congenital Malformations	Diseases of the Respiratory System	Diseases of the Nervous System	Suicide
	Number of Deaths (%)	27 (11.5)	11 (7.0)	16 (7.1)	32 (8.1)
4		Homicide	Congenital Malformations	Suicide	Malignant Neoplasms
	Number of Deaths (%)	20 (8.6)	10 (6.4)	15 (6.7)	24 (6.1)
5		Diseases of the Circulatory System	Diseases of the Nervous System	Diseases of the Circulatory System	Diseases of the Circulatory System
	Number of Deaths (%)	19 (8.1)	10 (6.4)	15 (6.7)	19 (4.8)

Source: Maryland Department of Health and Mental Hygiene, Vital Statistics Administration, Analyzed by the Center for Maternal and Child Health

- ***Economic security.*** Overall, Maryland's economic security is slightly higher than the national average. And while Maryland has some of the best medical centers in the country, it also has a large number of people who are uninsured and without access to health care. With a poverty rate of 8.8 percent for the overall population and 10.4 percent for children (Census Bureau, 2005), Maryland has some of the lowest poverty rates in the nation. However, incomes vary substantially, with concentrations of low income in Baltimore City and some of the more rural counties. Nationally, 18 percent of children are in poverty (Census Bureau, 2004a). However, the rate of child poverty varies geographically, ranging from a low of 3.8 percent in Howard County to a high of 30.6 percent in Baltimore City (Census Bureau, 2000). In 2000, Maryland's home ownership rate was 67.7 percent compared to 66.2 percent for the nation, with the median value of owner-occupied housing units at

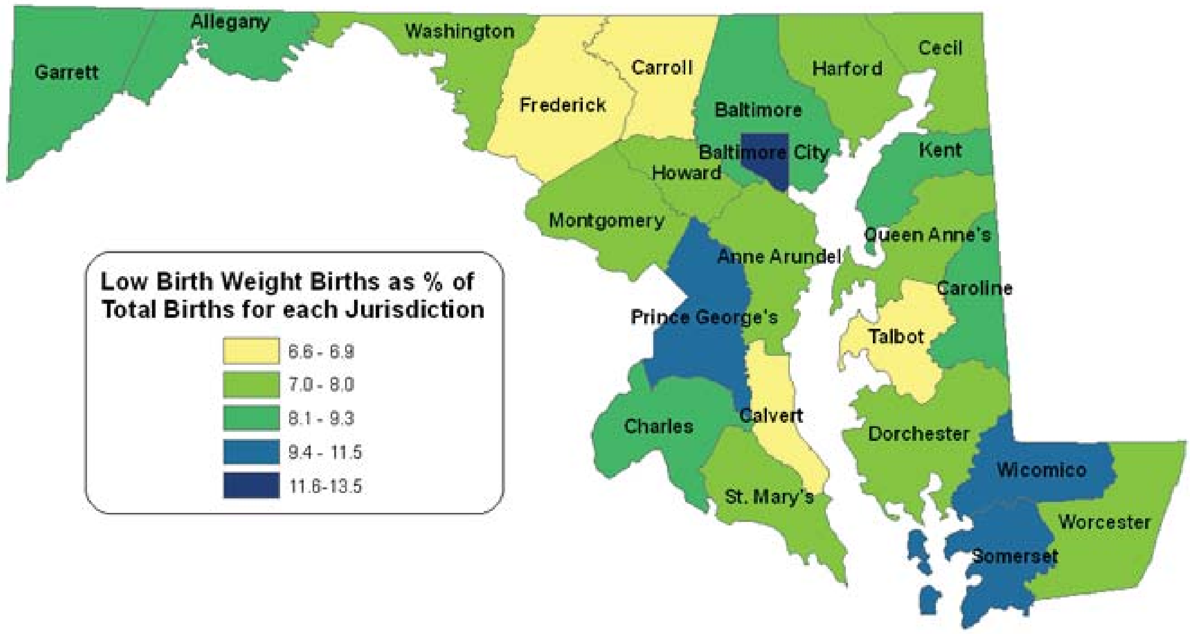

Figure A-1. Percentage of Low Birth Weight Infants by County, 2000 – 2005
Source: Maryland Department of Health and Mental Hygiene, Vital Statistics Administration data analyzed by the Center for Maternal and Child Health

$146,000 and $119,600 for the state and the nation respectively (Census Bureau, 2000). In 2004, in Maryland, 90.4 percent of children were covered by health insurance compared with 88.8 percent nationally (Census Bureau, 2004a).

- ***Education.*** Completion rates for high school and college indicate the extent to which students have attained a basic education and are prepared for higher levels of education or the workforce. Maryland has one of the highest educational attainments in the nation. In 2003, 84.7 percent of young adults

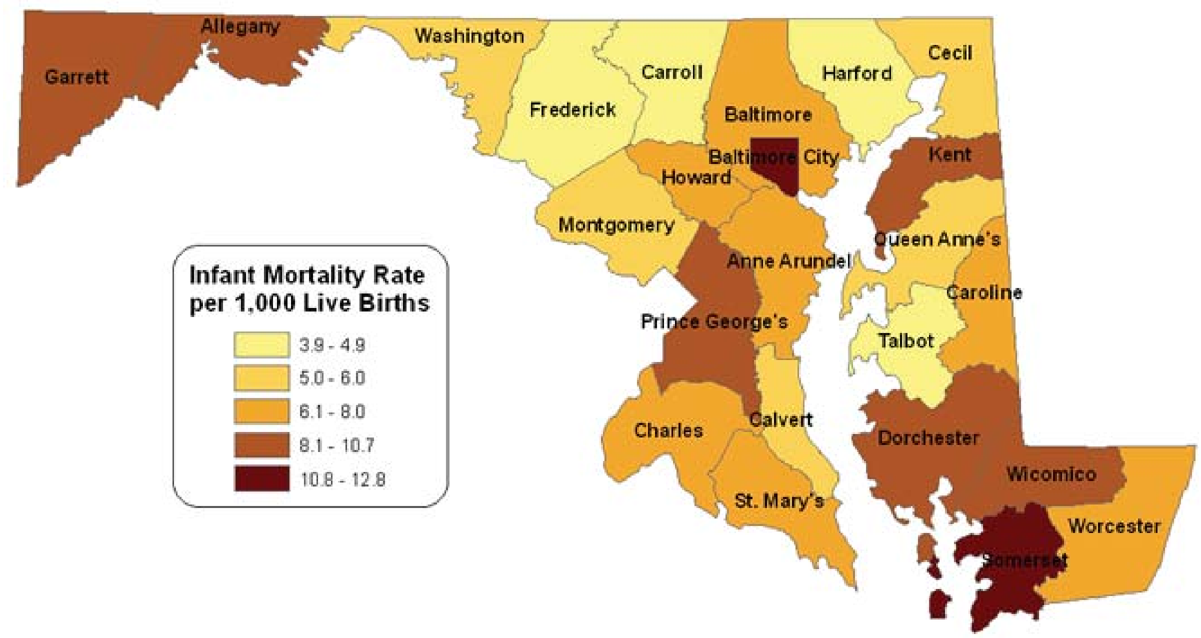

Figure A-2. Infant Mortality Rate by County, 2000 – 2005

Source: Maryland Department of Heealth and Mental Hygiene, Vital Statistics Administration data analyzed by the Center for Maternal and Child Health

ages eighteen through twenty-four completed high school and 38 percent of adults ages twenty-five through twenty-nine completed a bachelor's degree or higher compared to national rates of 78.7 percent and 28 percent, respectively.

- ***Language and cultural barriers.*** According to the 2003 American Community Survey (ACS), 12 percent of Maryland children between the ages of five through seventeen years spoke a language other than English at home (Census Bureau, 2004b) compared to the national average of 17 percent (Census Bureau, 2000).

Appendix B: Data and Methods

Most of the indicators include all children in Maryland under the age of 18, representing approximately 1.4 million individuals (Census Bureau, 2000). Similar to *America's Children and the Environment* (EPA, 2003), this report presents (where possible and meaningful) indicators for groups of children of different races and ethnicities and for children living in households with various levels of income.

The report uses five categories of race or ethnicity: White non-Hispanic, Black non-Hispanic, Hispanic, American Indian/Alaska Native, and Asian or Pacific Islander. In many cases, the data were insufficient to present results for the latter three categories, which often are aggregated into an "other" category. Also, it was not always specified in the original data source whether the White and Black categories were non-Hispanic so it was not possible in all cases to verify that this category did not include Hispanics.

The report uses three categories of family income: (1) below the poverty level (shown in graphs and tables as < Poverty Level); (2) between the poverty level and twice the poverty level (100 – 200 percent of Poverty Level); and (3) more than twice the poverty level (> 200 percent of Poverty Level). "Poverty level" is defined by the federal government and is based on income thresholds that vary by family size and composition. The category of incomes between the poverty level and twice the poverty level represents households that have relatively low incomes but are not below the officially defined poverty level. This category frequently is used by the Centers for Disease Control and Prevention in its reporting of health data and was used in the national report (EPA, 2003).

Outdoor Air Pollutants

E1: Trends in Average Daily Peak Ozone Concentrations

Indicator E1 is used to study the seasonal trends of daily peak ozone concentrations for all fixed monitors in Maryland. The curves represent an average of all eight-hour peak ozone values for all monitors in Maryland and are grouped by four-year periods in order to see a clearer picture of the trends without the noise of short-term fluctuations.

E2: Distribution of Annual Ozone Concentrations

The methods for interpolating data into grids or surfaces are described in "Interpolating Surfaces in ArcGIS Spatial Analyst" (http://www.esri.com/news/arcuser/0704/files/interpolating.pdf). The specific methods for this analysis are described in "Visualizing the Non-Attainment Extent of 8-Hour Ozone," Duc Nguyen, MDE. The tension spline method of data interpolation was used. Parameter values were selected to create a best fit of estimated and actual (monitored) data. The maps show contour lines of interpolated estimates of the "design values," three-year running averages of the fourth highest daily maximum eight-hour ozone concentrations at stationary monitors (calculated according to the Federal Register CFR Part 50—National Primary and Secondary Ambient Air Quality Standards). The interpolated values are placed in 5 ppb categories starting at ≥ 85 ppb.

E3: Percent of Children Exposed to Annual Ozone Concentrations Above the National Standard by Race

EPA's Office of Air Quality Planning and Standards has set health-based National Ambient Air Quality Standards (NAAQS) for seven common pollutants, often referred to as criteria pollutants. State and local environmental agencies conduct air monitoring programs to measure concentrations of these pollutants. The individual measurements are submitted to EPA for inclusion in a national database called the Air Quality System. EPA, as part of its data management system, identifies instances in which levels of air pollutants measured in the air are greater than the air quality standards. Each of these events is called an "exceedance." An exceedance occurs when a measured concentration exceeds a target value that is actually higher than the air quality standard. Concentrations measured in the air must be averaged over a time period set in accordance with the standard for that pollutant. The target values used to identify exceedances for the ozone eight-hour average standard is 0.08 ppm.

E4: Trends in Annual Average PM_{10} and $PM_{2.5}$ Concentrations

This measure represents the average annual PM concentrations experienced by children in Maryland and the Mid-Atlantic region expressed as a percentage of the annual standards for PM_{10} (50 micrograms per cubic meter, which was removed as an active standard by EPA in 2006) and $PM_{2.5}$ (15 micrograms per cubic meter). It is identical to Measure E3a in ACE (http://www.epa.gov/envirohealth/children/contaminants/data.htm#tablee3).

In the analysis, the product of a county's annual average PM concentration and children's population is determined and summed with other counties. This total is then divided by the sum of the county children's populations for counties with air quality data. The result is a children's population-weighted annual average concentration, giving more weight to counties with larger children's populations.

The measure uses the monitored daily average values reported in EPA's Air Quality System. Source-oriented and background-oriented monitors were excluded. For each year, monitors were excluded if they did not have at least six months of data with at least three daily averages in each month. In this manner, these analyses were generally restricted to population-oriented or highest-concentration-oriented monitors with at least 50 percent completeness.

E5: Percentage of Children Living in Counties Where Estimated Hazardous Air Pollutant Concentrations Were Greater Than Health Benchmarks

The indicator on hazardous air pollutants was developed using information from EPA's National Air Toxics Assessment (NATA) for 1999. As part of NATA, EPA estimated ambient concentrations of hazardous air pollutants for every county in the continental United States. EPA used a computer dispersion model to estimate these concentrations. In order to understand the limitations of the modeled ambient concentration estimates, EPA compared these estimates to available monitoring data from 1999 for the fourteen pollutants that had at least thirty monitors over a sufficiently large multi-state geographical area. The comparisons generally show that the model estimates are lower than the monitored concentrations for these pollutants. More information on NATA is available at http://www.epa.gov/ttn/atw/nata1999/.

Indoor Pollutants

E6: Percentage of Households Where Minors Age Less Than Five Have an Adult Smoker Resident

Maryland Adult Tobacco Survey (MATS) was a telephone survey of adults representing Baltimore City and Montgomery County. The survey, conducted from mid-February through mid-May 2002, produced completed telephone interviews with 3,560 adults, achieving a response rate of 43.3 percent in households containing an identified, eligible respondent. The Maryland Adult Tobacco Survey was conducted under a competitively awarded contract, as required under the legislation. ORC Macro (Macro International Inc.), a Maryland-based research organization, received the competitive contract.

For 1994 and 1998, exposure in the home was measured by data from the National Health Interview Survey (NHIS), administered by the Centers for Disease Control and Prevention's National Center for Health Statistics. Specifically, the measure indicates the percentage of children six years and under who are exposed regularly (four or more days per week) to secondhand smoke in the home. For 2003, data are from EPA Indoor Environments Division, National Survey on Environmental Management of Asthma and Children's Exposure to Tobacco Smoke. In addition, data were collected to provide information about children (under the age of eighteen), particularly those age six and under, exposed to environmental tobacco smoke (ETS) in the home. All interviews were conducted by telephone using a random digit dialing sampling methodology. A total of 14,685 households in the fifty states were contacted; of these, 2,504 interviews were conducted in households with children age six and under. To determine the exposure of children to ETS, a series of questions was administered in homes with children to determine whether residents and/or visitors smoked in the home, and if so, how often.

E7: Percentage of Women Who Smoke During Pregnancy

Information on cigarette smoking during pregnancy was gathered through the Pregnancy Risk Assessment Monitoring System (PRAMS). PRAMS is an ongoing project of the Centers for Disease Control and Prevention (CDC) with state health departments. PRAMS collects information from women who have recently delivered a baby to find out their attitudes and experiences immediately before, during and following their pregnancy. The Maryland Department of Health and Mental Hygiene started collecting PRAMS data in 2000. Women eligible to participate in PRAMS are randomly selected from Maryland's live birth certificate file. Beginning with January 2000 births, a stratified sample is drawn each month. The sample is stratified by race/ethnicity. Approximately 150 – 220 new mothers are selected each month. PRAMS combines two modes of data collection: a survey conducted by mailed questionnaire with multiple follow-up attempts and by telephone. Materials are available in English and Spanish.

E8: Proportion of Housing Stock Built Before 1950

The results for Maryland and U.S. pre-1950 housing stock are from the U.S. Census. The 1990 data are calculated from the Summary Tape File 3 (STF3)—Sample Data, Table H025, Year Structure Built. The 2000 data are calculated from the Census 2000 Summary File 3 (SF3)—Sample Data, Table H34, Year Structure Built.

Drinking Water Contaminants

E9: Percentage of Children Served by Community Water Systems That Did Not Meet All Applicable Health-based Drinking Water Standards

E10: Percentage of Children Living in Areas Served by Community Water Systems With Violations of Drinking Water Monitoring and Reporting Requirements

EPA maintains data about the size and performance of public water systems in the Safe Drinking Water Information System (SDWIS). The Violations file in SDWIS was used to identify all violations in each calendar year. For each type of violation and calendar year, only the first violation by a PWSID was selected. Violations that started and ended in different calendar years were included for each of the calendar years that intersect the violation period. For each type of violation and year, the population served by violating systems was obtained by summing the populations served across all of the violating systems. Then, the fractions of the populations served by violating systems were obtained by dividing these numbers by the total population served by all community water systems in the state for that year. Next, these fractions were multiplied by that year and state's population of children to obtain the estimated number of children served by violating systems for that year and state. Finally, the percentage of children served by violating water systems was obtained by dividing the number of children served by violating water systems by the total number of children in the state (or U.S.). The estimate assumes an even geographic distribution over water systems of individuals under the age of 18. Total populations served by community water systems were obtained from the pivot tables available at EPA (http://www.epa.gov/safewater/data/pivottables.html). County-level race and income data were obtained from the 2000 Census. Further description of the method is provided in America's Children and the Environment (EPA, 2006).

Note: A new standard for disinfection byproducts and revisions to the standard for surface water treatment was implemented in 2002. No other revisions to the standards have taken effect since 1993.

Pesticides

E11: Number of Pesticide-related Exposures in Children Reported to Maryland Poison Center

The Maryland Poison Center receives phone inquiries from the public, health care personnel and others regarding suspected or actual poisonings. Staff responds to inquiries and enters the call data in a data base.

Contaminants in Fish

E12: Average Concentrations of Contaminants in Recreational Fish

Since approximately 2000, the Maryland Department of the Environment has collected data from seventeen species of fish (plus crabs) in a total of seventy-eight water bodies, including multiple segments in major rivers. Sampling is done annually on a rotational basis. Laboratory analyses are conducted by a contract lab using EPA approved methods. The data are reevaluated each year to determine if new guidelines are needed, after which updated recommendations for individual water bodies (or categories, e.g., freshwater lakes and impoundments) and individual species are published on the MDE website and distributed in brochures. The meals-per-month recommendations are calculated according to EPA guidance.

Lead in Children

B1: Percentage of Children 0 – 72 Months of Age Tested for Lead and Percentage With Blood Lead Levels (≥10 μg/dl)

B2: Distribution of Concentrations of Lead In the Blood of Children 0 – 72 Months

The data for indicators B1 and B2 are taken from the Maryland Childhood Lead Registry (CLR) at the Maryland Department of the Environment, which collects results of all blood lead tests for children 0 – 18 years of age. Laboratory reporting is mandatory and MDE receives reports from twenty-five labs across the nation. More than 92 percent of tests are geo-coded at the census tract level, enabling improved comparisons by income. Results from rental and owner-occupied dwellings are combined in the analysis.

Respiratory Diseases in Children

D1: Percentage of Children Less Than 18 Years of Age With Asthma

Data regarding the prevalence of asthma in Maryland children are only available for 2005 and 2006. Data shown below were gathered from the Maryland Behavioral Risk Factor Surveillance System (BRFSS), which is ongoing, annual state-based telephone survey conducted of approximately 8,000 Marylanders greater than eighteen years of age. For questions related to children, the adults are asked to select one child within the home, then answer questions related to that child's environment and chronic conditions. The BRFSS is utilized to uniformly collect data on the behaviors and conditions associated with chronic diseases, injuries, and preventable infectious diseases.

D2: Rate of Children's Emergency Department Visits and Hospitalizations for Asthma and Other Respiratory Causes

Data for the number of ED visits were gathered from the Maryland Health Services Cost Review Commission (HSCRC) Ambulatory Care data for the years 2004 – 2006. All ED visits (defined as an encounter type of 2) for Maryland resident children less than eighteen years of age were selected if their primary diagnosis was identified as being in the following ranges using ICD9-CM codes:

- 493.00-493.92—Asthma
- 460-465.9—Acute Upper Respiratory Infection
- 466.0-466.19—Acute Bronchitis

Rates for the visits were computed by dividing the number of ED visits by the population of children less than eighteen years of age for each racial group. Population estimates were gathered from the Maryland Department of Planning.

Data for the number of hospital admissions were gathered from the Maryland HSCRC Inpatient Hospital Discharge data for the years 2003 – 2005. All records for Maryland resident children less than eighteen years of age were selected if they had a primary diagnosis of asthma (ICD9-CM codes between 493.00 – 493.92). Inpatient hospitalizations for Maryland resident children treated in hospitals in Washington, D.C. were captured from D.C. discharge data provided by the Maryland Health Care Commission. Rates were computed by dividing the number of inpatient hospitalizations by the population estimates for children under eighteen by county of residence for each race. Population estimates were gathered from the Vital Statistics Administration's Annual Reports for 2003 – 2005. The rates were then plotted by county using ArcGIS software (ESRI).

Childhood Cancer

D3: Overall Cancer Incidence and Mortality for Children Less Than 20

The Maryland Cancer Registry (MCR) collects, maintains, and reports on cancer incidence in the State of Maryland. The MCR was initiated in 1982, to collect all incident (new) cancers in the State of Maryland. The Maryland General Assembly enacted Maryland Health-General Articles §§18-203 and 18-204, effective July 1, 1991, that mandated reporting of all new cancer reports by hospitals, radiation therapy centers, and freestanding cancer diagnostic laboratories that were licensed in Maryland. The reporting law was amended in 1996 to include reporting of non-hospitalized cancer patients by freestanding ambulatory care facilities, and by physicians whose non-hospitalized cancer patients are not otherwise reported, beginning with cases diagnosed on or after October 1, 1996. In 2001, the Maryland General Assembly passed a law that required the reporting of benign brain and central nervous system tumors to the MCR, effective October 1, 2001.

Neurodevelopmental Disorders

D4: Rate of Neurodevelopmental Disorders Among Children 6 – 11 Years Old

For this report, the Maryland State Department of Education (MSDE), Special Education Child Count data were selected to reflect the burden of neurodevelopmental disorders in the child population. The Department compiles information concerning children's primary disability as identified under the Individuals with Disabilities Education Act (IDEA). The data are of high quality and available over a multi-year time period. The classification of educational disability conforms to national definitions and can be examined in a format similar to the national sample. It should be noted that these data do not reflect the cause of the educational disability nor do they reflect children's total neurodevelopmental status. However, we believe that this is the best data source currently available in Maryland that looks at children across the state with neurodevelopmental issues, an unknown portion of which may be attributed to environmental exposures. For this indicator, children ages six to eleven years are used because this is an age group where children are most likely to be included in the state data set. Census figures, instead of enrollment data, are used to determine rates of occurrence since children who are not enrolled in public school are also included in the data.

Data from a subset of children with conditions that are more likely to have a proportion attributable to environmental etiologies and for which there may be some diagnostic overlap are utilized as an indicator of neurodevelopmental disorders. This subset of conditions is referred to as the "neurodevelopmental subset," and includes mental retardation, developmental delay, speech and language impairment, specific learning disability, and autism.

Pesticide-Related Illnesses

D5: Emergency Department Visits for Acute Pesticide Exposure

Data for the number of children's ED visits were gathered from the Maryland Health Services Cost Review Commission (HSCRC) Ambulatory Care data for the years 2002 – 2006. All ED visits (defined as an encounter type of 2) for Maryland resident children less than eighteen years of age were selected if their primary diagnosis, other diagnoses, or Ecode were identified as being in the following ranges using ICD9--CM codes:

- 989.0-989.4—Cyanides, Strychnine, Chlorinated Hydrocarbons, Organophosphates, Carbamates, Other Pesticides—not classified
- E861.4—Disinfectants
- E863.0-E863.3—Insecticides—organochlorines, organophosphorus, carbamates, mixtures of insecticides, unspecified insecticides, herbicides, fungicides, rodenticides, fumigants, other pesticides
- E950.6—Suicide by agricultural chemical (excludes fertilizers)

Rates for the visits were computed by dividing the number of ED visits by the population of children less than eighteen years of age for each racial group. Population data from the Vital Statistics Administration was used for the years 2002 – 2005, and population estimates were gathered from the Maryland Department of Planning for 2006.

Appendix C: Glossary of Terms

Air Toxics: Synonym for "hazardous air pollutants" (see below).

Ambient Air: Outdoor air, any unconfined portion of the atmosphere, open air.

Asthma: A chronic inflammatory disorder of the lungs. Symptoms include wheezing, breathlessness, chest tightening, and cough.

Attention-Deficit/Hyperactivity Disorder: A disorder in which the prominent symptoms are hyperactivity, inattention, and impulsivity. Also referred to as ADD (attention deficit disorder).

Benzene: A colorless, volatile, flammable, toxic liquid aromatic hydrocarbon (C6H6) used in organic synthesis, as a solvent, and as a component of motor fuel. Benzene is a known human carcinogen and an important hazardous air pollutant.

Carbon Monoxide: A colorless, odorless, poisonous gas produced by incomplete combustion of fossil fuels; one of the six "criteria" pollutants for which EPA has set National Ambient Air Quality Standards under the Clean Air Act.

Chromium: A heavy metal that is an important hazardous air pollutant (see "heavy metals"). It is used for making steel, dyes and pigments, chrome plating, leather tanning, and wood preservation

Contaminant: Any physical, chemical, biological, or radiological substance or matter in air, water, or soil that can have adverse health effects.

Cotinine: A major metabolite of nicotine found in blood and urine. Currently regarded as the best biomarker for exposure of nonsmokers to environmental tobacco smoke.

Criteria Pollutant: One of the six pollutants for which EPA is required to set National Ambient Air Quality Standards to protect human health and welfare. Criteria pollutants include ozone (ground-level), carbon monoxide, particulate matter, sulfur dioxide, lead, and nitrogen oxides. They are called "criteria" pollutants because the Clean Air Act required EPA to describe the criteria for setting or revising standards.

Deciliter: One-tenth of a liter (0.1 liter).

Diesel: A petroleum-based fuel. Diesel exhaust is an important source of particulates and other pollutants that adversely affect human health.

Disinfection Byproducts: Organic and inorganic compounds that often result from the reaction between a disinfectant and naturally occurring materials in water; chloroform is a commonly found example.

Environmental Tobacco Smoke: Mixture of smoke exhaled by a smoker and the smoke from the burning end of the smoker's cigarette, pipe, or cigar. Also known as secondhand smoke. Environmental tobacco smoke is an important indoor air pollutant.

Epidemiological Studies: Studies that research the incidence, distribution, and control of disease in a population.

Exacerbation of Asthma: Increase in the frequency or severity of asthma attacks or symptoms in individuals who have asthma.

Exposure: Human contact with environmental contaminants in media, including air, water, soil, and food.

Gastrointestinal: Relating to, affecting, or including the stomach and/or intestine.

Ground Level Ozone: Ground-level ozone (smog) is formed by a chemical reaction between volatile organic pollutants (VOCs) and oxides of nitrogen (NO_X) in the presence of sunlight. Ozone concentrations can reach unhealthy levels when the weather is hot and sunny with little or no wind. Ozone at the ground level causes adverse effects on lung function and other adverse respiratory effects. It is one of the six "criteria" pollutants for which EPA has adopted National Ambient Air Quality Standards.

Hazardous Air Pollutants: Air pollutants identified in the Clean Air Act Amendments of 1990 as reasonably expected to cause or contribute to irreversible illness or death. Such pollutants include asbestos, beryllium, mercury, benzene, coke oven emissions, radionuclides, and vinyl chloride. A total of 188 hazardous air pollutants are listed in section 112(b) of the Clean Air Act, as amended in 1990. There are no ambient air quality standards for these pollutants.

Heavy Metals: Metallic elements with high atomic weights, e.g., mercury, chromium, cadmium, arsenic, and lead; can damage living things at low concentrations.

In Utero: In the uterus or before birth.

Ionizing Radiation: Radiation that can strip electrons from atoms, i.e., alpha, beta, and gamma radiation. High doses can cause massive tissue damage; lower doses can lead to cancer and harmful genetic mutations.

Leukemia: A cancer in which the body produces a large number of abnormal blood cells.

Media: Specific environments such as air, water, food, and soil.

Mercury: A heavy metal that is highly toxic if breathed or swallowed. The organic form of mercury, methylmercury, bioaccumulates in ecosystems and can cause adverse effects on children exposed before birth or adults at higher concentrations. The largest human-generated source of mercury emissions in the United States is the burning of coal. Other sources include the combustion of waste and industrial processes that use mercury.

Methylmercury: An organic form of mercury created from metallic or elemental mercury by bacteria in sediments. Methylmercury is easily absorbed into the living tissue of aquatic organisms and is not easily eliminated. Therefore, it accumulates in organisms at the top of food chains such as tuna or humans. It can cause adverse effects in children exposed before or after birth.

Microgram (µg): One-millionth of a gram.

Monitoring and Reporting Violation: Violation of monitoring and reporting requirements that specify how and when water must be tested for the presence of contaminants as defined by the Safe Drinking Water Act.

Mortality: The number of deaths in a population, or death rate.

National Ambient Air Quality Standards (NAAQS): Standards established by EPA for maximum allowable concentrations of six "criteria" pollutants in outdoor air. The six pollutants are carbon monoxide, lead, ground-level ozone, nitrogen dioxide, particulate matter, and sulfur dioxide. The standards are set at a level that protects public health with an adequate margin of safety.

National Priorities List: List of sites under EPA's Superfund program, which investigates and cleans up hazardous sites nationwide. Sites on the National Priorities List have undergone preliminary assessment and site inspection and have been determined to require remediation due to potential threats to persons living or working near the site.

Nitrates and Nitrites: Nitrogen-oxygen chemical units that combine with various organic and inorganic compounds. Once taken into the body, nitrates are converted into nitrites. The greatest use of nitrates is as a fertilizer. Other sources include animal manure and human sewage.

Nitrogen Dioxide (NO_2): A chemical that results from nitric oxide combining with oxygen in the atmosphere; a major component of photochemical smog. One of the six "criteria" pollutants for which EPA has set national ambient air quality standards.

Nitrogen Oxides (NO_x): A family of highly reactive gases (including nitrogen dioxide, above) that form when fuel is burned at high temperatures. Emitted principally from motor vehicle exhaust and stationary sources such as electric power plants and industrial boilers.

Ozone: A gas that results from complex chemical reactions between nitrogen dioxide and volatile organic compounds; the major component of smog. Ozone at the ground level is one of the six "criteria" pollutants for which EPA has established national ambient air quality standards.

Particulate Matter: Particles in the air, such as dust, dirt, soot, smoke, and droplets. Small particles (PM10 or $PM_{2.5}$) have significant effects on human health. Particulate matter is one of the six "criteria" pollutants for which EPA has established national ambient air quality standards.

Polychlorinated Biphenyls (PCBs): A group of toxic, persistent chemicals used in electrical transformers and capacitors for insulating purposes, and in gas pipeline systems as a lubricant. The sale and new use of PCBs were banned by law in 1979 although large reservoirs of PCBs remain in the environment.

Poverty Level: An income level below which an individual or family is considered poor. The U.S. Census Bureau defines poverty level based on a set of money income thresholds that vary by family size and composition. If a family's total income is less than that family's threshold, then that family, and every individual in it, is considered poor. The Census Bureau updates its poverty thresholds annually. In 2000, a family of two adults and two children with total income below $17,463 was considered below the poverty level. Tables showing the Census Bureau's poverty thresholds are available at http://www.census.gov/hhes/poverty/threshld.html.

Respiratory Effects: Effects on the process of breathing or on the lungs.

Solvents: Substances used to dissolve another substance. Some commonly used solvents, such as TCE, are important environmental contaminants.

Sudden Infant Death Syndrome (SIDS): The sudden and unexpected death of an apparently healthy infant, without an apparent cause.

Sulfur Dioxide (SO_2): A pungent, colorless, gaseous pollutant formed primarily by the combustion of fossil fuels. One of the six "criteria" pollutants for which EPA has set national ambient air quality standards.

Superfund: An EPA program to remediate sites contaminated by release of hazardous substances.

Activities include establishing a National Priorities List, investigating sites for inclusion on the list, determining their priority, and conducting and/or supervising cleanup and other remedial actions. Superfund is operated under the legislative authority of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA). Some remedial actions are funded directly by Superfund, through a tax on chemical feedstocks, but the majority are paid for by parties that are liable for the release of the hazardous substances.

Volatile Organic Compounds (VOCs): Carbon-containing compounds that easily go from a solid to a gaseous form at normal temperatures. Sources include household products such as paints, paint strippers, and other solvents; wood preservatives; aerosol sprays; cleansers and disinfectants; moth repellents and air fresheners; stored fuels and automotive products; hobby supplies; dry-cleaned clothing.