America's Children and the Environment, Third Edition

DRAFT Indicators

Environments and Contaminants: Indoor Environments

EPA is preparing the third edition of *America's Children and the Environment* (ACE3), following the previous editions published in December 2000 and February 2003. ACE is EPA's compilation of children's environmental health indicators and related information, drawing on the best national data sources available for characterizing important aspects of the relationship between environmental contaminants and children's health. ACE includes four sections: Environments and Contaminants, Biomonitoring, Health, and Special Features.

EPA has prepared draft indicator documents for ACE3 representing 23 children's environmental health topics and presenting a total of 42 proposed children's environmental health indicators. This document presents the draft text, indicators, and documentation for the indoor environments topic in the Environments and Contaminants section.

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Indoor Environments

Children spend most of their time in indoor environments, including homes, schools, child care facilities, and other buildings.[1] Pollutants in indoor environments can come from many different sources, including combustion sources such as furnaces, gas stoves, fireplaces, and cigarettes; building materials and furnishings such as treated wood, paints, furniture, carpet, and fabrics; consumer goods such as electronics; cleaning products, pesticides, and other products used for maintenance of the home or building; and products used for hobbies, science projects, arts and crafts projects, and other activities.

Chemicals emitted from these and other sources, such as carbon monoxide, benzene, and formaldehyde, are frequently present in indoor air in homes, schools, and other buildings.[2] The chemicals found indoors or measured in indoor air are numerous and diverse: hundreds of chemicals have been measured in indoor air, including multiple pesticides, fragrance-related compounds, polychlorinated biphenyls (PCBs), phthalates, combustion byproducts, and other compounds.[3,4]

Children may also be routinely exposed to chemical contaminants that accumulate in dust, including lead, pesticides, brominated flame retardants, phthalates, and perfluorinated chemicals such as perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA).[2,5-8] Many pesticides and other chemicals that break down relatively quickly outdoors are much more persistent and long-lasting indoors, where they are less exposed to natural elements such as sunlight, moisture, and microorganisms that can accelerate the breakdown of chemicals.[9-11]

Infants and small children may have the highest exposure to house dust contaminants due to their frequent and extensive contact with floors, carpets, and other surfaces where dust gathers, as well as their frequent hand-to-mouth activity. However, children of all ages (as well as adults) are likely to be exposed to dust contaminants through hand-to-mouth activity[1,12] and other ingestion pathways, such as the settling of dust onto food and food preparation surfaces in the kitchen.

The indoor environments of personal cars and school buses are also important to children's exposure, as a child can spend up to an average of 84 minutes per day in a vehicle, depending on his or her age.[1] School bus cabins can have levels of fine particulate matter ($PM_{2.5}$) four times higher than levels in ambient air.[13] In addition, children riding school buses in urban areas are likely to be exposed to elevated levels of benzene, formaldehyde, and other pollutants in motor vehicle emissions. It is estimated that school buses commuting through congested urban areas may contribute up to 30% of a child's daily exposure to diesel engine-related pollutants.[14] Adult smoking in personal cars can have a significant impact on children's environmental tobacco smoke exposures, as smokers' cars tend to have significantly higher air nicotine concentrations than non-smokers' cars do.[15]

Pollutants in indoor environments can also come from outside sources. For example, pollutants in outdoor air will penetrate to the indoor environment,[16,17] and contaminants from workplaces, streets, or lawns may be carried into the home on people's shoes or clothing.[18,19] Some contaminants in drinking water can enter indoor air through uses of hot water such as showering.[20,21] In areas where groundwater is contaminated, chemicals may enter indoor environments via vapor intrusion.[22,23] Radon, a gaseous radioactive element that causes lung cancer, is found in soils and can enters homes through cracks in the foundation and other entry points.[24]

Other contaminants of the indoor environment include dust mites, molds, and allergens from pests such as cockroaches.[25,26]

The following indicators present data on environmental tobacco smoke and lead dust hazards in children's homes. Other indoor environmental hazards in children's homes generally lack nationally representative data necessary for development of indicators. Indicator E5 presents data on environmental tobacco smoke, based on national survey data on homes with young children where someone smokes regularly. Indicator Dust 1 presents data on lead dust hazards in children's homes. Further information on these issues is provided in the following sections. In addition, indoor environments in children's schools and in child care facilities are discussed in the Special Features section of this report.

Environmental Tobacco Smoke

Environmental tobacco smoke (ETS), also known as secondhand smoke, is a mixture of thousands of chemicals released when someone smokes tobacco. Components of ETS include nicotine, benzene, formaldehyde, acrolein, sulfur dioxide, and nitrogen oxides. At least 250 chemicals found in ETS are known to be toxic or carcinogenic.[27] ETS is released into the air directly from the burning of tobacco, and when cigarette or pipe smokers exhale the tobacco smoke they have directly inhaled.

Children and infants who are exposed to ETS are at increased risk for a number of adverse health effects, including lower respiratory tract infections, bronchitis, pneumonia, impaired lung function, and ear infections.[28-31] ETS can play a role in the development and exacerbation of asthma and other wheeze illnesses, particularly for children under 6 years of age.[30-37] Exposure to ETS is also a known cause of sudden infant death syndrome (SIDS).[29,30] Young children appear to be more susceptible to the respiratory effects of ETS than are older children.[31,33]

The exposure of a pregnant woman to ETS can also be harmful to her developing fetus. Exposure of pregnant women to ETS has been linked to a reduction in birth weight and increased risk of low birth weight, fetal mortality, preterm delivery, and spontaneous abortion.[30,32,38-44] Research suggests that the combination of prenatal and postnatal exposure to ETS may lead to some childhood cancers.[30] A review study found that prenatal exposure to ETS is associated with impaired lung function and increased risk of developing asthma.[45] Additionally, the exposure of pregnant women to ETS has been associated with significantly lower measurements of cognitive development in their children.[46]

Exposure to ETS in the home is influenced by adult behaviors, including the decisions to smoke at home and to allow visitors to smoke inside the home. Children living in homes with smoking bans have significantly lower levels of cotinine (a biological marker of exposure to ETS) in urine than children living in homes without smoking bans.[47] Household smoking bans can significantly decrease children's exposures to ETS, but do not completely eliminate them.[48]

Parental smoking status inside the home greatly affects children's exposures to ETS, but research suggests a difference in impact between maternal and paternal smoking. Maternal smoking is associated with higher cotinine levels in children, and maternal smoking appears to have a greater effect on lower respiratory illnesses than does paternal smoking.[30] Although research suggests the existence of adverse health outcomes in households with only paternal smoking, the relationship between maternal smoking and adverse health outcomes is more strongly established.[30]

In recent years there has been a significant decline in children's exposures to ETS.[49] This reduction is in part attributable to a decline in the percentage of adults who smoke. In 2008, an estimated 20.6% of adults were current smokers, down from 25.0% in 1993.[50,51] In addition, the prevalence of smoke-free households increased from 43% of U.S. homes in 1992–1993 to 72% in 2003.[52] However, despite the increasing numbers of adults disallowing smoking in the home, approximately 34% of children live in a home with at least one smoker as of 2009.[53]

Lead in House Dust

The ingestion of lead-contaminated house dust is the primary pathway of current childhood exposure to lead.[54] Children have a greater risk of exposure to lead-contaminated dust than that of adults, due to their frequent and extensive contact with floors, carpets, and other surfaces where dust gathers, as well as their high rate of hand-to-mouth activity. Additionally, lead-contaminated dust particles are more readily absorbed into the body than soil or paint chips, and children's bodies absorb up to 10 times more ingested lead than adults do as a result of their less-developed gastrointestinal pathways.[55] Children living in homes with higher levels of lead-contaminated dust tend to have higher blood lead levels.[56-61]

Lead dust is composed of fine particles of soil, paint, and other settled industrial or automotive emissions from the outdoor and indoor air.[62] Residences with deteriorated lead-based paint tend to have higher levels of lead in house dust and the surrounding soil.[54,63] Deteriorated lead-based paint that is cracked, peeling, or chipped can be ingested directly by children or can mix with and contaminate house dust, which can also be ingested.[64] Normal wear as the result of cleaning activities or repeated surface friction can lead to further deterioration and the release of lead-based paint particles.[65] Any house built before 1978 may contain lead-based paint. As of the year 2000, approximately 38 million older housing units in the United States still contained lead-based paint.[54]

Home maintenance and renovation activities, such as sanding, cutting, demolition, and painting, can create hazardous lead dust and chips and have been associated with higher levels of lead dust and blood lead in children. Beginning in 2010, all contractors performing renovation, repair, and painting projects that disturb lead-based paint in pre-1978 homes, child care facilities, and schools must be certified and follow specific work practices to prevent lead contamination.[63]

Lead-contaminated soil is another contributor to lead in house dust. Known sources of lead in soil include historical airborne emissions from leaded gasoline use, emissions from industrial sources such as smelters, and lead-based paint. Current sources of lead in ambient air in the United States include smelters, ore mining and processing, lead acid battery manufacturing, and coal combustion activities, such as electricity generation.[61] Lead-contaminated dust and soil from the outdoors can be transported into the home after becoming airborne via soil resuspension, or can be tracked into the home by occupants or family pets.[55]

Childhood exposure to lead has been associated with reduced cognitive function;[58,66-71] learning disabilities;[72] and behavioral problems, such as attention-deficit disorder.[73-80] The Centers for Disease Control and Prevention (CDC) defines a blood lead level of 10 micrograms per deciliter (µg/dL) as "elevated." This definition is used to identify children for blood lead case management.[81,82] However, the CDC specifically notes that "no level of lead in a child's blood can be specified as safe,"[83] and adverse effects of lead on intelligence and behavior have been observed at blood lead levels lower than 10 µg/dL.[58,67-71,73-77,80,84,85] Scientific findings provide clear evidence of cognitive deficits in young children with blood-lead concentrations in the range of 5-10 µg/dL, with evidence of effects at blood lead levels as low as 2µg/dL.[61]

The current federal standards indicate that floor and window lead dust should not exceed 40 micrograms of lead per square foot ($\mu g/ft^2$) and 250 $\mu g/ft^2$, respectively, in order to protect children from developing "elevated" blood lead levels as defined by the CDC. EPA is currently reviewing the lead dust standards to determine whether they should be lowered.[86] A study of about 500 children in Rochester, New York, found that floor dust lead levels much lower than the floor standard of 40 $\mu g/ft^2$ were associated with a significant excess risk of children having blood lead levels greater than 10 µg/dL.[58]

Childhood blood lead and house dust levels in the United States differ across groups in the population, such as those defined by socioeconomic status, race/ethnicity,[87] and geographic location. Children living in poverty and Black non-Hispanic children tend to have higher blood lead levels[56,58] and higher levels of lead-contaminated dust in the home than do White non-Hispanic children.[88] Blood lead levels tend to be higher for children living in older housing, most likely because older housing units are more likely to contain lead-based paint.[88,89] Additionally, housing in the Northeast and Midwest has twice the prevalence of lead-based paint hazards compared with housing in the South and West,[62] possibly due to the older housing stock in those areas.

Indicator E5: Percentage of children ages 0 to 6 years regularly exposed to environmental tobacco smoke in the home, 1994 and 2005

Overview

Indicator E5 presents the percentage of children ages 0 to 6 years regularly exposed to environmental tobacco smoke (ETS) in the home. The data are from a national survey that collects health information from a representative sample of the population. The survey provides data on children exposed to ETS in the home on four or more days per week for the years 1994 and 2005. The focus is on children ages 6 years and under because these younger children have been specifically identified as more susceptible to the effects of tobacco smoke.

National Health Interview Survey

The data for this indicator come from the National Health Interview Survey (NHIS) for 1994 and 2005. The NHIS is a large-scale household interview survey of a representative sample of the civilian noninstitutionalized U.S. population, conducted by the Centers for Disease Control and Prevention. In 1994, interviews were conducted for about 5,450 children ages 0 to 6 years, and ETS exposure information was reported for about 5,390 of those children. In 2005, interviews were conducted for about 10,100 children ages 0 to 6 years, and ETS exposure information was reported for about 7,800 of those children. Questions related to smoking in the home are included in the NHIS in only selected years. In 1994, the NHIS asked, “Does anyone who lives here smoke cigarettes, cigars, or pipes anywhere inside this home?” Similarly, in 2005, the NHIS asked, “In a usual week, does ANYONE who lives here, including yourself, smoke cigarettes, cigars, or pipes anywhere inside this home?” Relevant follow-up questions were then asked according to the response. The NHIS also included questions about smoking in the home in the 1998 survey, but the questions used in 1998 provide data that are not directly comparable to the 1994 and 2005 data.[i]

Data Presented in the Indicator

The indicator presents data from NHIS for the percentage of children ages 0 to 6 years living in homes where someone smokes on a regular basis (defined as four days or more per week). Studies have found that questionnaire data on smoking in the home are accurate in predicting blood levels of cotinine (a metabolite of nicotine used as a marker of ETS exposure) in children,[36,90] and researchers have used these data to identify effects on childhood lung function and other health outcomes from exposure to ETS.[30]

We focus on children ages 0 to 6 years because these younger children have been specifically identified as more susceptible to the effects of tobacco smoke and are targeted by the indicator

[i] The question used in 2005 was repeated in the 2010 NHIS; 2010 data are not yet available.

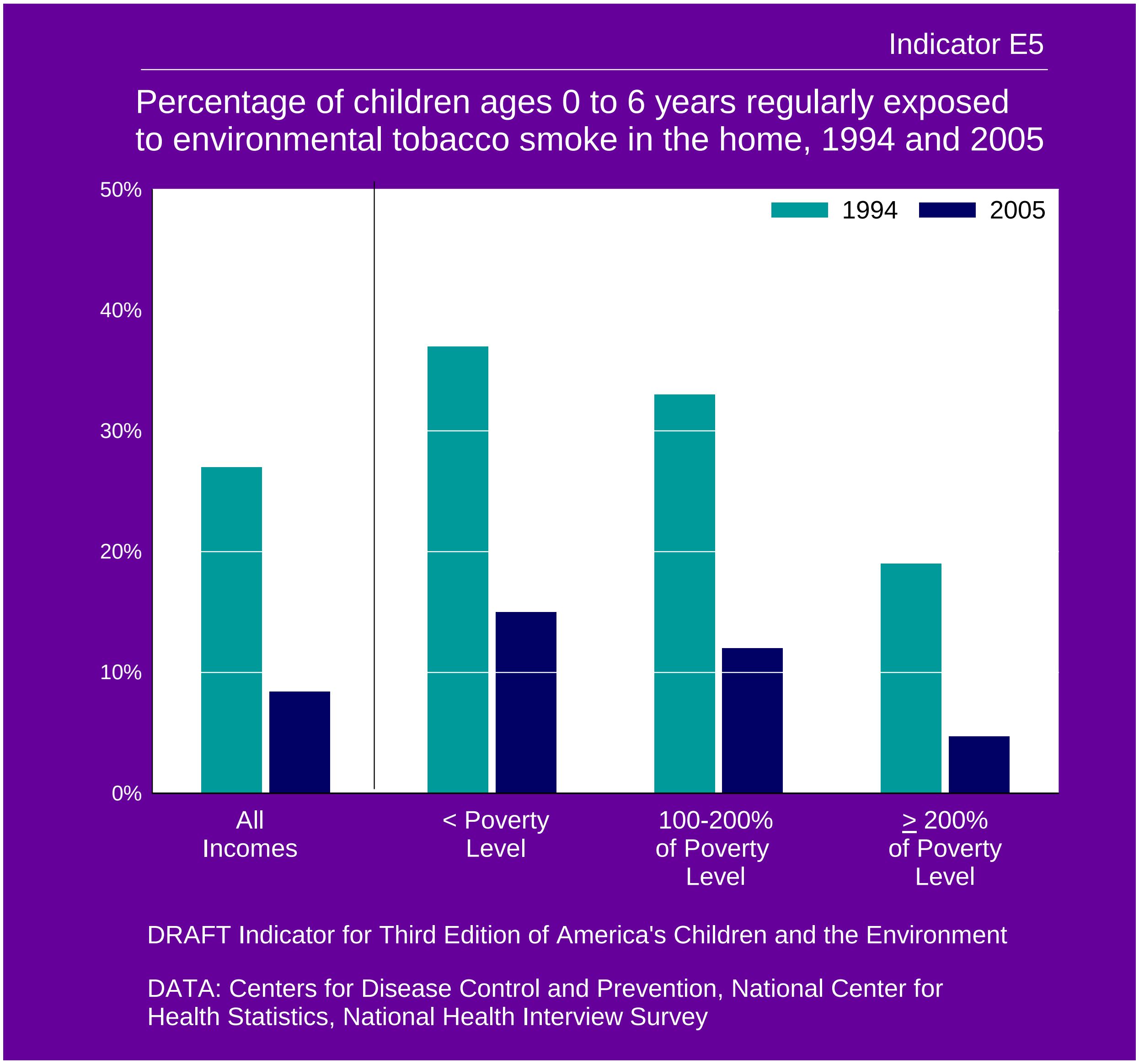
used in the federal government's Healthy People 2010 initiative.[91] Children ages 6 years and under also have less control over their environment and are likely to spend more time in close proximity to adult caregivers.[30]

The indicator presents data on children's exposures to ETS in the home for 1994 and 2005, based on household income level. Additional information regarding ETS exposures for different race/ethnicity groups is presented in Table E5a.

Statistical Testing

Statistical analysis has been applied to the 2005 data to determine whether any differences between demographic groups are statistically significant. These analyses use a 5% significance level ($p \leq 0.05$), meaning that a conclusion of statistical significance is made only when there is no more than a 5% chance that the observed difference between demographic groups occurred randomly. It should be noted that when statistical testing is conducted for differences among multiple demographic groups (e.g., considering both race/ethnicity and income level), the large number of comparisons involved increases the probability that some differences identified as statistically significant may actually have occurred randomly.

A finding of statistical significance depends not only on the numerical difference in the value of a reported statistic between two groups, but also on the number of observations in the survey and various aspects of the survey design. For example, the statistical test is more likely to detect a difference between two groups when data have been obtained from a larger number of people in those groups. A finding that there is or is not a statistically significant difference between two groups is not the only information that should be considered when determining the public health implications of those differences.



- In 2005, the percentage of children ages 0 to 6 years living in homes where someone smoked regularly was 8%, compared with 27% in 1994.

- Children living in homes with family incomes below the poverty level were more likely than their peers at higher income levels to be living in homes where someone smoked regularly. In 2005, 15% of children below the poverty level lived in homes where someone smoked regularly, compared with 12% of children in homes with incomes between 100–200% of poverty level, and 5% of children in homes with incomes at least twice the poverty level. These differences were statistically significant.

- In the same year, 22% of White non-Hispanic children below poverty lived in homes where someone smoked regularly, compared with 16% of Black non-Hispanic children and 7.4% of Hispanic children living below poverty. (See Table E5a.)
    - Statistical Note: The differences in the prevalence of exposure to environmental tobacco smoke between White non-Hispanic and Hispanic children below poverty, and between Black non-Hispanic and Hispanic children below poverty, were statistically significant. The differences in the prevalence of exposure to environmental tobacco smoke between White non-Hispanic and Black non-Hispanic children below poverty were not statistically significant.

Indicator Dust1: Percentage of children ages 0 to 5 years living in homes with interior lead hazards, 1998–1999 and 2005–2006

Overview

This indicator shows the percentage of children ages 0 to 5 years who lived in homes with interior lead-based paint hazards. The data are from two nationally representative surveys of homes conducted in 1998–1999 and 2005–2006. The surveys involved collection of dust, soil, and paint samples from homes and measurement of the lead levels in these samples. The focus of the indicator is on children ages 0 to 5 years, due to the elevated exposures that occur during early childhood and the sensitivity of the developing brain to the effects of lead.

NSLAH/AHHS

The United States Department of Housing and Urban Development (HUD) has conducted two nationally representative surveys of housing in the United States to assess children's potential household exposure to lead and other contaminants. The American Healthy Homes Survey (AHHS) was conducted from 2005–2006 to update the National Survey of Lead and Allergens in Housing (NSLAH), which was conducted from 1998–1999. AHHS also included measurements of arsenic, pesticides, and mold.

Samples of paint, dust, and soil were taken from 831 total housing units (184 units with children ages 0 to 5 years) in NSLAH, and 1,131 total housing units (206 units with children ages 0 to 5 years) in AHHS. The lead sampling components of AHHS were designed to be very similar to NSLAH so that results of the two studies could be compared.

Lead-Based Paint Hazards

NSLAH and AHHS used federal guidelines to identify homes with lead-contaminated dust, deteriorated lead-based paint, and lead-contaminated soil hazards.

EPA has established standards under Title X of the Toxic Substances Control Act (TSCA), section 403, for identifying lead-based paint hazards in all housing built before 1978. These standards were adopted by HUD under the Lead Safe Housing Act, which applies to all federally owned or assisted housing in the United States. According to these regulations, a significant lead-based paint hazard is the presence of deteriorating lead-based paint, lead-contaminated dust, or lead-contaminated soil above federal standards.

For lead-contaminated dust, there are separate standards for dust on the floor and dust on windowsills. Floor dust samples should not have more than 40 micrograms of lead per square foot (μg/ft^2) and window dust samples should not have more than 250 μg/ft^2.[64,92]

Additionally, current federal health-based standards qualify a significantly deteriorated lead-based paint hazard as the deterioration of an area of lead-based paint greater than 20 square feet (exterior) and 2 square feet (interior) for large-surface items, such as walls and doors; or damage to more than 10% of the total surface area of small-surface components—such as windowsills, baseboards, and trim—with lead-based paint.

The level of deterioration is an important variable in exposure. The presence of lead-based paint alone is not necessarily indicative of a significant hazard, and intact paint is believed to pose very little risk to occupants.[93] However, deteriorated lead-based paint that is cracked, peeling, or chipped can be ingested directly by children or can contaminate house dust that can be inhaled or ingested by children.[64]

Indicator Dust1 presents the data from NSLAH and AHHS concerning lead hazards inside the home, in three categories.

The first category, "interior lead dust," presents the percentage of children ages 0 to 5 years living in homes with a lead dust hazard, based on the number of homes with dust containing levels of lead that exceeded the levels defined by HUD's Lead Safe Housing Rule. The second category, "interior deteriorated lead-based paint," displays the percentage of children ages 0 to 5 years who lived in homes with significantly deteriorated lead-based paint indoors as defined by HUD's Lead Safe Housing Rule. The last category, "either interior lead dust or interior deteriorated lead-based paint," represents the percentage of children living in homes with an interior dust hazard, a deteriorated lead-based paint hazard, or both.

This indicator represents the potential for children's indoor exposure to lead based solely on the percentage of children ages 0 to 5 years living in homes with levels of lead-based paint and dust above federal standards. The indicator does not represent differences in paint lead levels, paint deterioration levels, or the amount of lead in the dust above the standards.

Survey records identify the race/ethnicity and income level of survey respondents; however, estimates of lead hazards in the home for children ages 0 to 5 years broken out by race/ethnicity and income are not statistically reliable, due to the relatively small number of homes in each group. Therefore, the indicator provides data only for all children ages 0 to 5 years combined.

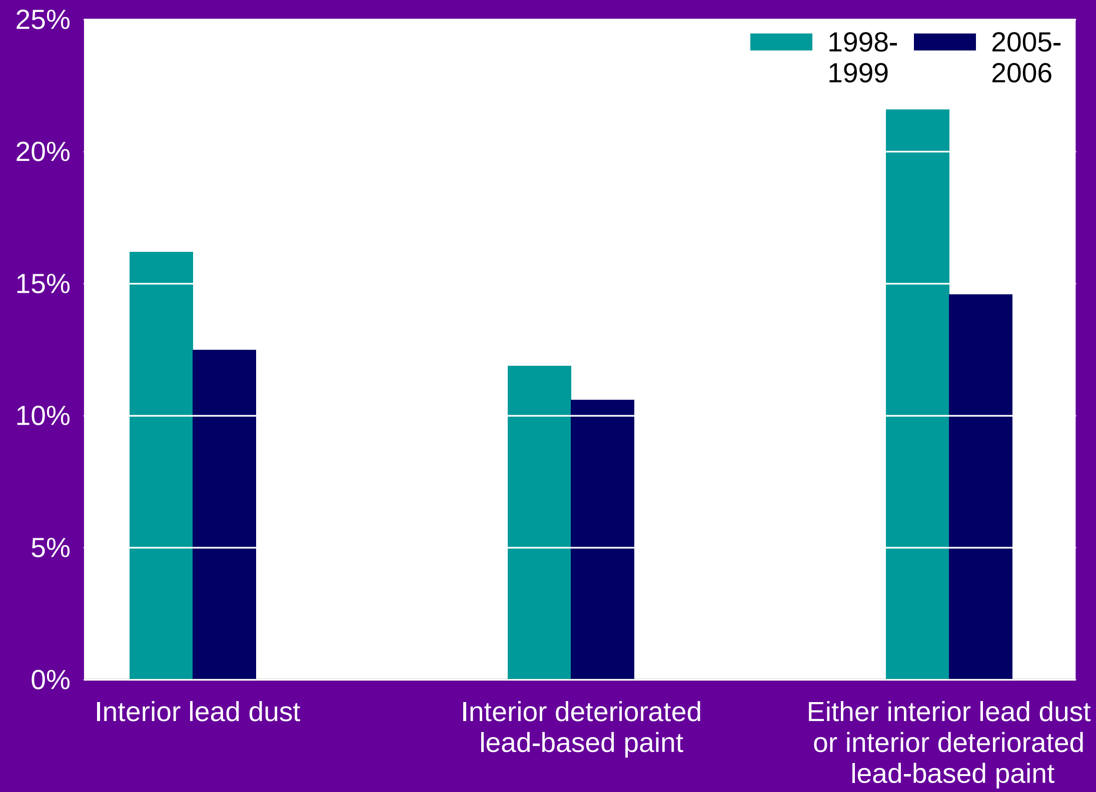
Statistical Testing

Statistical analysis has been applied to the indicator to determine whether any changes over time are statistically significant. These analyses use a 5% significance level ($p \leq 0.05$), meaning that a conclusion of statistical significance is made only when there is no more than a 5% chance that the observed change over time occurred randomly.

A finding of statistical significance depends not only on the numerical difference in the value of a reported statistic over time, but also on the number of observations in the survey and various aspects of the survey design. For example, the statistical test is more likely to detect a difference over time when data have been obtained from a larger number of people in each time period. A finding that there is or is not a statistically significant difference over time is not the only information that should be considered when determining the public health implications of the difference.

Indicator Dust1

Percentage of children ages 0 to 5 years living in homes with interior lead hazards, 1998-1999 and 2005-2006



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DATA: U.S. Department of Housing and Urban Development, National Survey of Lead and Allergens in Housing, American Healthy Homes Survey

- The percentage of children ages 0 to 5 years living in homes with an interior lead dust hazard was 16.2% in 1998–1999, and 12.5% in 2005–2006.

- The percentage of children ages 0 to 5 years living in homes with an interior deteriorated lead-based paint hazard was 11.9% in 1998–1999 and 10.6% in 2005–2006.

- The percentage of children ages 0 to 5 years living in homes with either an interior lead dust hazard or an interior deteriorated lead-based paint hazard was 21.6% in 1998–1999 and 14.6% in 2005–2006.

- Changes in percentages between the two surveys were not statistically significant.

Data Tables

Table E5: Percentage of children ages 0 to 6 years regularly exposed to environmental tobacco smoke in the home, by family income

Year	All Incomes	< Poverty Level	100-200% of Poverty Level	≥ 200% of Poverty Level
1994	27.3%	37.1%	32.7%	18.5%
2005	8.4%	14.6%	11.7%	4.7%

DATA: Centers for Disease Control and Prevention, National Center for Health Statistics, National Health Interview Survey

Table E5a: Percentage of children ages 0 to 6 years regularly exposed to environmental tobacco smoke in the home, by race/ethnicity and family income, 2005

Race / Ethnicity	All Incomes	< Poverty Level	≥ Poverty Level	≥ Poverty (Detail)	
				100-200% of Poverty Level	≥ 200% of Poverty Level
All Races/Ethnicities	8.4%	14.6%	6.8%	11.7%	4.7%
White non-Hispanic	9.1%	21.5%	7.5%	15.7%	5.2%
Black or African-American non-Hispanic	12.0%	15.9%	9.3%	15.3%	4.3%*
Asian non-Hispanic	NA**	NA**	NA**	NA**	NA**
American Indian/Alaska Native non-Hispanic	NA**	NA**	NA**	NA**	NA**
Hispanic	4.3%	7.4%	2.6%	3.2%	1.9%
Mexican	3.9%	5.6%	2.8%	3.3%*	2.4%*
Puerto Rican	9.3%	19.2%	NA**	NA**	NA**
Other†	10.4%	20.4%*	7.9%*	NA**	9.0%*

DATA: Centers for Disease Control and Prevention, National Center for Health Statistics, National Health Interview Survey

† "Other" includes non-Hispanic respondents whose race is neither White, Black, or Asian, or who report multiple races.

* The estimate should be interpreted with caution because the standard error of the estimate is relatively large: the relative standard error, RSE, is at least 30% but is less than 40% (RSE = standard error divided by the estimate).

** The estimate is not reported because it has large uncertainty: the relative standard error, RSE, is at least 40% (RSE = standard error divided by the estimate).

Table Dust1: Percentage of children ages 0 to 5 years living in homes with interior lead hazards, 1998–1999 and 2005–2006

Year	Interior Lead Dust	Interior Deteriorated Lead-Based Paint	Either Interior Lead Dust or Interior Deteriorated Lead-Based Paint
1998-1999	16.2%	11.9%	21.6%
2005-2006	12.5%	10.6%	14.6%

DATA: U.S. Department of Housing and Urban Development, National Survey of Lead and Allergens in Housing, American Healthy Homes Survey

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Metadata

Metadata for	**National Health Interview Survey (NHIS)**
Brief description of the data set	The National Health Interview Survey (NHIS) collects data on a broad range of health topics through personal household interviews. The results of NHIS provide data to track health status, health care access, and progress toward achieving national health objectives.
Who provides the data set?	Centers for Disease Control and Prevention, National Center for Health Statistics.
How are the data gathered?	Data are obtained using a health questionnaire through a personal household interview. Interviewers obtain information on health history and demographic characteristics, including age, household income, and race and ethnicity from respondents, or from a knowledgeable household adult for children age 17 years and younger.
What documentation is available describing data collection procedures?	See http://www.cdc.gov/nchs/nhis.htm for detailed survey documentation by survey year.
What types of data relevant for children's environmental health indicators are available from this database?	Health history (e.g., asthma, mental health, childhood illnesses). Smoking in residences (for selected years). Demographic information. Health care use and access information.
What is the spatial representation of the database (national or other)?	NHIS sampling procedures provide nationally representative data, and may also be analyzed by four broad geographic regions: North, Midwest, South and West. Analysis of data for any other smaller geographic areas (state, etc.) is possible only by special arrangement with the NCHS Research Data Center.
Are raw data (individual measurements or survey responses) available?	Data for each year of the NHIS are available for download and analysis (http://www.cdc.gov/nchs/nhis/nhis_questionnaires.htm). Annual reports from the NHIS are also available (http://www.cdc.gov/nchs/nhis/nhis_products.htm) as are interactive data tables (http://www.cdc.gov/nchs/hdi.htm). The files available for download generally contain individual responses to the survey questions; however, for some questions the responses are categorized Some survey responses are not publicly released.
How are database files obtained?	Raw data: http://www.cdc.gov/nchs/nhis.htm.
Are there any known data quality or data analysis concerns?	Data are self-reported, or (for individuals age 17 years and younger) reported by a knowledgeable household adult, usually a parent. Responses to some demographic questions (race/ethnicity, income) are statistically imputed for survey participants lacking a reported response.
What documentation is available describing QA procedures?	http://www.cdc.gov/nchs/data/series/sr_02/sr02_130.pdf provides a summary of QA procedures.
For what years are data	Data from the NHIS are available from 1957–present. Availability of data

Metadata for	National Health Interview Survey (NHIS)
available?	addressing particular issues varies based on when questions were added to the NHIS. The survey is redesigned on a regular basis; many questions of interest for children's environmental health indicators were modified or first asked with the redesign that was implemented in 1997. For environmental tobacco smoke (regular smoking in the home), comparable data are available for 1994 and 2005.
What is the frequency of data collection?	Annually.
What is the frequency of data release?	Annually.
Are the data comparable across time and space?	Survey design and administration are consistent across locations and from year to year. Many questions were revised or added in 1997, so data for prior years may not be comparable to data from 1997 to present.
Can the data be stratified by race/ethnicity, income, and location (region, state, county or other geographic unit)?	Race, ethnicity, income. Region (four regions only).

Metadata for	American Healthy Homes Survey (AHHS)
Brief description of the data set	A nationally representative sample of homes was selected for this survey. AHHS measured levels of lead, lead hazards, and allergens in homes nationwide. AHHS also surveyed additional potential health hazards such as arsenic, pesticides, and molds. The lead and arsenic data included the levels of lead in paint, dust and soil, and arsenic in dust and soil, and levels of paint deterioration.
Who provides the data set?	U.S. Department of Housing and Urban Development (HUD).
How are the data gathered?	Data were collected from participants in private and public residences. A 3-stage cluster sample was used to select a nationally representative sample of 1,131 homes. Samples were collected via surface wipes from four common living areas, homeowner vacuum bags, and soil samples from outside the home. Lead testing in paint was conducted using a portable X-Ray Fluorescence (XRF) instrument. Demographic and other information was collected using a questionnaire. All samples and survey information were collected during a single day.
What documentation is available describing data collection procedures?	http://www.hud.gov/offices/lead/NHHC/presentations/R-15_Findings_from_AHH_survey.pdf**.** Slide four and five of the presentation. American Healthy Homes Survey, Draft Final Report. June, 2009.
What types of data relevant for children's environmental health indicators are available from this database?	Environmental contaminants: lead paint, lead dust, lead in soils, mold, allergens/endotoxins in dust, arsenic in soil, indoor moisture measurements, indoor pesticide residues. Housing type and age. Demographic information on residents (age, race, income group, ethnicity). Electrical safety, Structural stability, Moisture, Pest control, Ventilation, Injury prevention, Fire safety, Deterioration of carpet, Plumbing facilities.
What is the spatial representation of the database (national or other)?	National.

Metadata for	American Healthy Homes Survey (AHHS)
Are raw data (individual measurements or survey responses) available?	Not currently.
How are database files obtained?	HUD provided data files directly to EPA for purposes of developing an indicator for America's Children and the Environment. Summary tables are available in "American Healthy Homes Survey, Final Report, Lead and Arsenic Findings," June 2009, Draft Final Report (not yet publicly released).
Are there any known data quality or data analysis concerns?	None reported.
What documentation is available describing QA procedures?	"American Healthy Homes Survey, Final Report, Lead and Arsenic Findings," June 2009, Draft Final Report (not yet publicly released).
For what years are data available?	2005/2006.
What is the frequency of data collection?	Data were collected once, from June 2005 to March 2006.
What is the frequency of data release?	The report and data have not yet been publicly released.
Are the data comparable across time and space?	As a one-time survey, time comparisons within the AHHS are not possible, but AHHS results can be compared with the earlier NSLAH survey (1999-2000). Geographic comparisons should be possible using the raw data, since the same data were collected at all homes. The Draft Final Report gives some comparisons between the four Census regions.
Can the data be stratified by race/ethnicity, income, and location (region, state, county or other geographic unit)?	Residents' age, race, ethnicity, and household income. Census region. Data can also be stratified by year of home construction. and by the housing type (rented or owned). However, estimates of lead hazards in the home for children ages 0 to 5 years broken out by race/ethnicity and income are not statistically reliable, due to the relatively small number of homes in each group.

Metadata for	National Survey of Lead and Allergens in Housing (NSLAH)
Brief description of the data set	A nationally representative sample of homes was selected for this survey. NSLAH measured levels of lead, lead hazards, allergens, and endotoxins in homes nationwide. The lead data included the levels of lead in paint, dust and soil, and levels of paint deterioration.
Who provides the data set?	National Institute of Environmental Health Sciences (NIEHS) and U.S. Department of Housing and Urban Development (HUD).
How are the data gathered?	A nationally representative sample of 1,984 housing units in which children could reside was drawn from 75 primary sampling units and 831 eligible housing units were recruited and completed a survey. Measurements of lead paint and dust were gathered from the surveyed homes in specific rooms; soil lead was gathered from the surveyed homes through core sampling.
What documentation is available describing data collection procedures?	National Survey of Lead and Allergens in Housing. Final Report. Volume I. Analysis of Lead Hazards. April 2001. At http://www.nchh.org/Portals/0/Contents/Article0312.pdf. National Survey of Lead and Allergens in Housing. Draft Final Report.

Metadata for	National Survey of Lead and Allergens in Housing (NSLAH)
	Volume II. Design and Methodology. March 2001.
What types of data relevant for children's environmental health indicators are available from this database?	Lead-based paint hazards in housing (prevalence, deteriorated, loadings), dust lead, and soil lead (children's play areas, yard). Indoor allergens (dust mite, cockroach, cat, dog, mouse, Alternaria), endotoxins. Race, ethnicity, age, sex, income. Asthma and allergies health history. Housing characteristics: building age, heating, cooling, and cooking equipment. Pets and pests. Pesticide data were not collected.
What is the spatial representation of the database (national or other)?	National.
Are raw data (individual measurements or survey responses) available?	Not currently.
How are database files obtained?	Data have not been publicly released. HUD provided data files directly to EPA for purposes of developing an indicator for America's Children and the Environment. Summary tables are obtained from: National Survey of Lead and Allergens in Housing. Final Report. Volume I. Analysis of Lead Hazards. April 2001. At http://www.nchh.org/Portals/0/Contents/Article0312.pdf. NSLAH data summaries are also available in "American Healthy Homes Survey, Final Report, Lead and Arsenic Findings," June 2009, Draft Final Report (not yet publicly released).
Are there any known data quality or data analysis concerns?	http://www.nchh.org/Portals/0/Contents/Article0312.pdf. Chapter 7 of the study report outlines sources of error in data collection and analysis. Concerns include: response rate, non-response bias, and measurement errors.
What documentation is available describing QA procedures?	http://www.nchh.org/Portals/0/Contents/Article0312.pdf. Chapter 7, sections 7.4 ("Quality of Field Data Collection") and section 7.5 ("Paint Testing Quality Assurance"), pages 7-32 through 7-36.
For what years are data available?	The main field study (survey and in-home lead) was conducted in 1998-1999, with an augmentation of the soil sampling in 2000.
What is the frequency of data collection?	Data were collected once, from 1998-1999, with an augmentation of the soil sampling in 2000.
What is the frequency of data release?	Raw data have not been publicly released. The report was published in April 2001.
Are the data comparable across time and space?	As a one-time survey, time comparisons within the NSLAH are not possible, but NSLAH results can be compared with the later AHHS survey (2005-2006). Geographic comparisons should be possible using the raw data, since the same data were collected at all homes.
Can the data be stratified by race/ethnicity, income, and location (region, state, county or other geographic unit)?	Residents' age, race, ethnicity, and household income. Census region. Data can also be stratified by year of home construction. and by the housing type (rented or owned). However, estimates of lead hazards in the home for children ages 0 to 5 years broken out by race/ethnicity and income are not statistically reliable, due to the relatively small number of homes in each group.

Methods

Indicator

E5. Percentage of children ages 0 to 6 years regularly exposed to environmental tobacco smoke in the home.

Summary

Since 1957, the National Center for Health Statistics, a division of the Centers for Disease Control and Prevention, has conducted the National Health Interview Survey (NHIS), a series of annual U.S. national surveys of the health status of the noninstitutionalized civilian population. This indicator shows the percentage of children ages 0 to 6 years who are exposed regularly (four or more days per week) to environmental tobacco smoke (ETS) in the home. For each household, the NHIS survey includes survey weights and demographic information for all members of the household. Smoking information from the sampled adults in the household was obtained from supplementary files. The responses from all the adults in the household were combined to give an overall household answer to whether or not there was regular exposure to ETS in the home. Percentages are calculated by combining positive responses for each household with the survey weights for each child in the survey. The survey weights are the annual numbers of children in the noninstitutionalized civilian population represented by each child. Table E5 reports percentages for all children and by family income for the years 1994 and 2005. Table E5a reports percentages by race/ethnicity and family income for 2005.

Data Summary

Indicator: E5. Percentage of children ages 0 to 6 years regularly exposed to environmental tobacco smoke in the home

Time Period	1994 or 2005	
Data	Prevalence of exposure in the home to environmental tobacco smoke (ETS) for four or more days in a week in children ages 0 to 6 years	
Year	1994	2005
ETS exposure non-missing responses	5,387	7,765
ETS exposure missing responses	51	2,325

Overview of Data Files

The following files are needed to calculate this indicator. The files together with the survey documentation and SAS programs for reading in the data are available at the NHIS website: http://www.cdc.gov/nchs/nhis.htm.

- NHIS 1994: Person file personsx.asc, Year 2000 Objectives Supplement file year2000.asc. The personsx.asc file is an ASCII file containing interview data for all persons. The year2000.asc file is an ASCII file that contains supplementary interview data including household smoking variables. The variables needed for these analyses are age (AGE), survey weight (WTFA), whether or not someone smokes inside the home (SMOKEHOM), and the number of days per week that residents smoke in the home (NDSMOKHM).

- NHIS 2005: Person file personsx.dat, Sample Adult Cancer file cancerxx.dat, Imputed income files incmimp1.dat, incmimp2.dat, incmimp3.dat, incmimp4.dat, and incmimp5.dat. The personsx.dat file is an ASCII file containing demographic and other data for all persons living in the sampled households. The cancerxx.dat file is an ASCII file that contains supplementary cancer-related interview data for sampled adults including the household smoking variable LVDYSMOK that gives the number of days per week with smoking in the home. The two files were sorted using the identifier variable for the household (HHX). The values of LVDYSMOK for the sampled adult household members were combined to create a summary smoking variable SMK4DYWK for each household. The SMK4DYWK variable was merged with the personsx.dat file using the household identifier, HHX. From each of the imputed income files we need the imputed poverty income ratio (RAT_CATI), which gives the poverty income ratio category calculated from the reported exact family income, if available, or else gives the imputed category randomly generated by multiple imputation using regression models. The Person and Imputed Income files are sorted and merged using the identifiers HHX, FMX, and FPX. The other variables needed for these analyses are age (AGE_P), person survey weight (WTFA), the race (RACERPI2), the Hispanic origin (ORIGIN_I), the specific Hispanic origin (HISPAN_I), the pseudo-stratum (STRATUM), and the pseudo-PSU (PSU).

National Health Interview Survey (NHIS)

Since 1957, the National Center for Health Statistics, a division of the Centers for Disease Control and Prevention, has conducted the National Health Interview Survey (NHIS), a series of annual U.S. national surveys of the health status of the noninstitutionalized civilian population.

Results are calculated from responses to the following survey questions:

In NHIS 1994:

- SMOKEHOM: “Does anyone who lives here smoke cigarettes, cigars, or pipes anywhere inside this home?” If yes, then the following question was asked:
- NDSMOKHOM: “On the average, about how many days per week do people who live here smoke anywhere inside this home?”

In NHIS 2005:

- LIVINTRO: "In a usual week, does ANYONE who lives here, including yourself, smoke cigarettes, cigars, or pipes anywhere inside this home?" If yes, then the following question was asked:
- LVDYSMOK: "Usually, about how many days per week do people WHO LIVE here smoke anywhere INSIDE this home?"

For both years, the questionnaire was designed so that if the first question was not answered positively, the second question about the numbers of days of smoking per week was skipped, and thus given a missing value for the response.

For each home surveyed, we assumed that there was regular exposure to ETS if one or more of the adult respondents answered the second question about the number of days of smoking per week and said that there were four or more days of smoking per week.

The NHIS uses a complex multi-stage, stratified, clustered sampling design. Certain demographic groups have been deliberately over-sampled. Oversampling is performed to increase the reliability and precision of estimates of health status indicators for these population subgroups. In 1994, Blacks were over-sampled. In 2005, Blacks and Hispanics were over-sampled. The publicly released data includes survey weights to adjust for the over-sampling, non-response, and non-coverage. The statistical analyses used the survey weights (WTFA) to re-adjust the responses to represent the total national population for each year.

Race/Ethnicity and Family Income

For this indicator, the prevalence percentages were calculated for demographic strata based on family income and race/ethnicity. Family income strata were used for the main table; the supplementary table gives results for the combined stratification of family income and race/ethnicity.

The family income was characterized based on the RAT_CATI variable, which gives the level of the ratio of the family income to the poverty level. The National Center for Health Statistics obtained the family income for the respondent's family during the family interview. The U.S. Census Bureau defines annual poverty level money thresholds varying by family size and composition. The poverty income ratio (PIR) is the family income divided by the poverty level for that family. The public release variable RAT_CATI gives the value of the PIR for various ranges, Under 0.5, 0.5-0.74, 0.75 to 0.99, …, 4.50-4.99, 5.00 and Over.

Family income was stratified into the following groups:

- Below Poverty Level: $PIR < 1$, i.e., RAT_CATI = 1, 2, or 3.
- Between 100% and 200% of Poverty Level: $1 \leq PIR < 2$, i.e., RAT_CATI = 4, 5, 6, or 7.
- Above 200% of Poverty level: $PIR \geq 2$, i.e., RAT_CATI = 8, 9, 10, 11, 12, 13 or 14.
- Above Poverty Level: $PIR \geq 1$ (combines the previous two groups).
- Unknown Income: PIR is missing ("undefinable"), i.e., RAT_CATI = 96.

Approximately 33% of families did not report their exact family income in 2005. In 2005, the majority of these families either reported their income as two categories (above or below $20,000) or as 44 categories.[ii] In 2005, 91% of families either gave the exact income or the two-category response.

NCHS reports[iii] evidence that the non-response to the income question is related to person-level or family-level characteristics, including items pertaining to health. Therefore, treating the missing responses as being randomly missing would lead to biased estimates. To address this problem, NCHS applied a statistical method called "multiple imputation" to estimate or "impute" the family income based on the available family income and personal earnings information and on responses to other survey questions. A series of regression models were used to predict the exact family income from the available responses. Five sets of simulated family income values were generated for each family that did not report their exact family income. In this manner, NCHS generated five data sets, each containing a complete set of family income values (either the reported or the imputed values). The poverty income ratio categories were calculated from the income values and the family size and composition variables. An estimated prevalence percentage was computed for each of the five data sets. The overall estimated prevalence percentage is the arithmetic mean of the five estimates.

Race was characterized using the race variable for the 1997 OMB standards,[iv] RACERPI2. The possible values of this variable are:

- 1. White only
- 2. Black / African American only
- 3. American Indian Alaska Native (AIAN) only
- 4. Asian only
- 5. Race group not releasable
- 6. Multiple race

The Native Hawaiian or Other Pacific Islander (NHOPI) race group is not specified in the public release version due to confidentiality concerns. Respondents with the single race NHOPI have RACERPI2 = 5 and respondents of multiple races including NHOPI have RACERPI2 = 6.

[ii] The 44 categories are listed in the NHIS family questionnaires for each year found at http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm. The categories were $0-$999, $1,000-$1,999, …, 34,000-$34,999, $35,000-$39,999, $40,000-$44,999, $45,000-$49,999, …, $70,000-$74,999, $75,000 and above.

[iii] "Multiple imputation of family income and personal earnings in the National Health Interview Survey: methods and examples," http://www.cdc.gov/nchs/data/nhis/tecdoc.pdf , August, 2008.

[iv] Revised race standards were issued by the Office of Management and Budget in 1997 and were to be fully implemented across the federal statistical system by January 2003. Under the new standards, the minimum available race categories include: White, Black, AIAN, Asian, and Native Hawaiian or Other Pacific Islander (NHOPI). A very important change was that under the new standards, respondents may select more than one race category.

The ORIGIN_I variable indicates whether or not the ethnicity is Hispanic or Latino. ORIGIN_I = 1 if the respondent is Hispanic or Latino. ORIGIN_I = 2 if the respondent is not Hispanic or Latino.

The HISPAN_I variable indicates the specific Hispanic origin or ancestry.

- 00 Multiple Hispanic
- 01 Puerto Rico
- 02 Mexican
- 03 Mexican-American
- 04 Cuban/Cuban American
- 05 Dominican (Republic)
- 06 Central or South American
- 07 Other Latin American, type not specified
- 08 Other Spanish
- 09 Hispanic/Latino/Spanish, non-specific type
- 10 Hispanic/Latino/Spanish, type refused
- 11 Hispanic/Latino/Spanish, type not ascertained
- 12 Not Hispanic/Spanish origin

The race/ethnicity was defined based on RACERPI2, ORIGIN_I, and HISPAN_I:

Race/ethnicity:

- White non-Hispanic: RACERPI2 =1, ORIGIN_I = 2
- Black or African-American non-Hispanic: RACERPI2 = 2, ORIGIN_I = 2
- Asian non-Hispanic: RACERPI2 = 4, ORIGIN_I = 2
- Hispanic: ORIGIN_I = 1
    - Mexican: ORIGIN_I = 1 and HISPAN_I = 02, 03
    - Puerto Rican: ORIGIN_I = 1 and HISPAN_I = 01
- Other: RACERPI2 = 3, 5 or 6, ORIGIN_I = 2
    - American Indian / Alaska Native, non-Hispanic: RACERPI2 = 3, ORIGIN_I = 2

The "Other" category includes non-Hispanic respondents reporting multiple races, or reporting a single race that is neither White, Black, African-American, or Asian.

Some respondents gave missing or incomplete answers to the race/ethnicity questions. In those cases NCHS applied a statistical method called "hot-deck imputation" to estimate or "impute" the race or ethnicity based on the race/ethnicity responses for other household members, if available, or otherwise based on information from other households. The NHIS variables ORIGIN_I , HISPAN_I, and RACERPI2 use imputed responses if the original answer was missing or incomplete.

Calculation of Indicator

Indicator E5 is the percentage of children ages 0 to 6 years regularly exposed to ETS inside the home. "Regularly" is interpreted as an average of four or more days per week. For the year 2005 data, the following calculations were applied to the publicly released data. For the year 1994 data, CDC staff performed the calculations using similar methods applied to their unreleased version of the database.

For 2005, the NHIS question LIVINTRO asked sampled adults if anyone living in the residence smokes anywhere inside the home and, if the answer was Yes, the NHIS question LVDYSMOK asked for the average number of days per week there is smoking anywhere inside the home by anyone living in the residence. LVDYSMOK has the following values:

- Missing if LIVINTRO ≠ 1 ("Yes") or if LVDYSMOK not asked.
- 0, 1, 2, 3, 4, 5, 6, or 7 if 0, 1, 2, 3, 4, 5, 6, or 7 days smoking per week
- 97 if "refused"
- 98 if "not ascertained"
- 99 if "don't know"

For each sampled adult in the adult cancer file, the following ETS variable was calculated:

- ETS = No (0-3 days smoking per week) if LVDYSMOK = Missing, 0, 1, 2, 3
- ETS = Yes (4-7 days smoking per week) if LVDYSMOK = 4, 5, 6, 7
- ETS = Missing (unknown) if LVDYSMOK = 97, 98, 99

Since the responses from different adults in the household sometimes differ, these ETS responses were combined to give a summary smoking variable SMK4DYWK for each household, identified by the variable HHX. SMK4DYWK indicates whether there is smoking anywhere inside the home on four or more days per week:

- SMK4DYWK = 1 (Yes) if ETS = Yes for one or more adults in the household
- SMK4DYWK = 2 (No) if ETS = Yes for zero adults in the household and ETS = No for one or more adults in the household
- SMK4DYWK = Missing if ETS = Missing for all adults in the household

The value of SMK4DYWK for each household was merged into the personsx.dat Person file using the household identifier variable HHX.

The rest of the calculation uses the Person file data for every child ages 0 to 6 years. Note that this sample of children includes all children ages 0 to 6 years in each sampled household. This is a larger sample than the children in the NHIS Sample Child file, which has only one child per family. To illustrate the calculations we will apply them to children of all incomes. We have rounded all the numbers to make the calculations easier:

We begin with all the non-missing responses to the SMK4DYWK question for children ages 0 to 6 years. Assume for the sake of simplicity that Yes or No responses were available for every sampled child. Each sampled child has an associated survey weight that estimates the annual number of children represented by that sampled child. For example, the first response for a child aged 6 or under was No with a survey weight of 4,000, and so represents 4,000 children ages 6 years or under. A second child aged 6 years or under had a No response with a survey weight of 4,000, and so represents 4,000 children ages 6 years or under. The third child aged 6 years or under had a Yes response with a survey weight of 3,000, and so represents 3,000 children ages 6 years or under. The total of the survey weights for the sampled children equals 28 million, the total U.S. population of children ages 6 years or under in 2005.

To calculate the proportion of children exposed to ETS, we can use the survey weights to expand the data to the total 2005 U.S. population of 28 million children ages 0 to 6 years. We have 4,000 No responses from the first child, 4,000 No responses from the second child, 3,000 Yes responses from the third child, and so on. Of these 28 million responses, a total of 2.3 million responses are Yes and the remaining 25.7 million are No. Thus 2.3 million of the 28 million children were exposed to ETS more than four days per week, giving a percentage of 8% (2.3/28).

In reality, the calculations need to take into account that Yes or No responses were not reported for every respondent, and they need to use exact rather than rounded numbers. There were non-missing SMK4DYWK responses for 7,765 of the 10,090 sampled children ages 0 to 6 years. The survey weights for all 10,090 sampled children add up to 28.0 million, the total 2005 U.S. population of children ages 0 to 6 years. The survey weights for the 7,765 sampled children with non-missing responses add up to 21.7 million. Thus the available data represent 21.7 million children, which is 77% of the 2005 U.S. population of children ages 0 to 6 years. The survey weights for the Yes responses add up to 1.8 million, which is 8% of the population with responses (1.8 million/21.7 million = 8%). Thus we divide the sum of the weights for participants with Yes responses by the sum of the weights for participants with non-missing responses. These calculations assume that the sampled children with non-missing responses are representative of the children with missing responses.

For calculation of prevalence by income group, we use the five sets of imputed income values, which each give different results. Suppose we wish to estimate the percentage of all children ages 0 to 6 years below the poverty level that were regularly exposed to ETS in the home. Using the above calculation method applied for children ages 0 to 6 years below the poverty level, the proportions for the five sets of imputed values are: 14.69%, 14.36%, 14.36%, 14.77%, and 14.74%. The estimated proportion of children ages 0 to 6 years below the poverty level regularly exposed to ETS in the home is given by the average of the five estimates, (14.69 + 14.36 + 14.36 + 14.77 + 14.74) / 5 = 14.59%.

<u>Equations</u>

The following equations give the mathematical calculations for the example of all children ages 0 to 6 years below the poverty level. Let w(i) denote the survey weight for the i'th surveyed child of ages 0 to 6 years. Exclude any surveyed children with a response other than Yes or No to the SMK4DYWK variable. Let the response indicator c(i) = 1 if the i'th surveyed child had a Yes response and let c(i) = 0 if the i'th surveyed child had a No response. Let the income indicator d(i, j) = 1 if the i'th surveyed child was below the poverty level according to the j'th set of imputed values and let d(i, j) = 0 if the i'th surveyed child was not below the poverty level according to the j'th set of imputed values.

1. Fix j = 1, 2, 3, 4 or 5. Sum (over i) all the survey weights multiplied by the income indicators to get the total weight W(j) for set j:

$$W(j) = \Sigma\, w(i) \times d(i, j)$$

2. Fix j = 1, 2, 3, 4 or 5. Sum (over i) all the survey weights multiplied by the response indicators and multiplied by the income indicators to get the total weight D(j) for set j for children below the poverty level with a Yes response:

$$D(j) = \Sigma\, w(i) \times c(i) \times d(i, j)$$

3. Divide D(j) by W(j) to get the percentage of children regularly exposed to ETS in the home in set j:

$$\text{Percentage } (j) = (D(j) / W(j)) \times 100\%$$

4. Average the percentages across the 5 sets to get the estimated percentage of children regularly exposed to ETS in the home:

$$\text{Percentage} = [\text{Percentage } (1) + \text{Percentage } (2) + \text{Percentage } (3) + \text{Percentage } (4) + \text{Percentage } (5)] / 5$$

If the demographic group of interest includes all incomes, then the percentages will be equal for all five sets of imputed values, so the calculation in steps 1 to 3 need only be done for j =1, and step 4 is not required.

Relative Standard Error

The uncertainties of the percentages were calculated using SUDAAN® (Research Triangle Institute, Research Triangle Park, NC 27709) statistical survey software. SUDAAN was used to calculate the estimated percentages and the standard errors of the estimated percentages. The standard error is the estimated standard deviation of the percentage, and this depends upon the survey design. The standard error calculation also incorporates the extra uncertainty due to the multiple imputations of the income variables (based on the variation between the estimated percentages from each of the five sets of imputations). For this purpose, the public release version of NHIS includes the variables STRATUM and PSU, which are the Masked Variance Unit pseudo-stratum and pseudo-primary sampling unit (pseudo-PSU). For approximate variance estimation, the survey design can be approximated as being a stratified random sample with replacement of the pseudo-PSUs from each pseudo-stratum; the true stratum and PSU variables are not provided in the public release version to protect confidentiality.

The relative standard error is the standard error divided by the estimated percentage:

$$\text{Relative Error (\%)} = [\text{Standard Error (Percentage)} / \text{Percentage}] \times 100\%$$

Percentages with a relative error less than 30% were treated as being reliable and were tabulated. Percentages with a relative error greater than or equal to 30% but less than 40% were treated as being unstable; these values were tabulated but were flagged as being unstable. Percentages with a relative standard error greater than or equal to 40%, or without an estimated relative standard error, were treated as being unreliable; these values were not tabulated and were flagged as having a large uncertainty.

Questions and Comments

Questions regarding these methods, and suggestions to improve the description of the methods, are welcome. Please use the “Contact Us” link at the bottom of any page in the America’s Children and the Environment website.

Statistical Comparisons

For this indicator, the question of interest for each child is whether or not they were regularly exposed to ETS in the home. Statistical analyses of the percentages of children with a positive response to the question of interest were used to determine whether the differences between percentages for different demographic groups were statistically significant. Using a logistic regression model, the logarithm of the odds that a given child has a positive response is assumed to be the sum of explanatory terms for the child’s age group, sex, income group and/or race/ethnicity. The odds of a positive response is the probability of a positive response divided by the probability of a negative response. Thus if two demographic groups have similar (or equal) probabilities of a positive response, then they will also have similar (or equal) values for the logarithm of the odds. Using this model, the difference in the percentage between different demographic groups is statistically significant if the difference between the corresponding sums of explanatory terms is statistically significantly different from zero. The uncertainties of the regression coefficients were calculated using SUDAAN® (Research Triangle Institute, Research Triangle Park, NC 27709) statistical survey software to account for the survey weighting and design. A p-value at or below 0.05 implies that the difference is statistically significant at the 5% significance level. No adjustment is made for multiple comparisons.

For these statistical analyses we used two income groups, below poverty level, and at or above poverty level. The small number of children with unknown (and unimputed) incomes were included in the at or above poverty level group. For the main analyses we also used five race/ethnicity groups: White non-Hispanic; Black non-Hispanic; Asian non-Hispanic; Hispanic; Other. In addition, for specific comparisons between the Mexican and Puerto Rican subgroups, we applied a similar statistical analysis using three ethnicity groups: Mexican; Puerto Rican; Other Hispanic or Non-Hispanic. We did not include the age group in these analyses.

For each type of comparison, we present unadjusted and adjusted analyses. The unadjusted analyses directly compare a percentage between different demographic groups. The adjusted analyses add other demographic explanatory variables to the statistical model and use the statistical model to account for the possible confounding effects of these other demographic variables. For example, the unadjusted race/ethnicity comparisons use and compare the percentages between different race/ethnicity pairs. The adjusted analyses add sex and income terms to the statistical model and compare the percentages between different race/ethnicity pairs after accounting for the effects of the other demographic variables. For example, if White non-Hispanics tend to have higher family incomes than Black non-Hispanics, and if the prevalence of exposure to ETS strongly depends on family income only, then the unadjusted differences between these two race/ethnicity groups would be significant but the adjusted difference (taking into account income) would not be significant.

Comparisons of the prevalence of regular exposure to ETS in the home in children ages 0 to 6 years between pairs of race/ethnicity groups are shown in Table 1. For the unadjusted "All incomes" comparisons, the only explanatory variables are terms for each race/ethnicity group. For these unadjusted comparisons, the statistical tests compare the percentage for each pair of race/ethnicity groups. For the adjusted "All incomes (adjusted for sex, income)" comparisons, the explanatory variables are terms for each race/ethnicity group together with terms for each sex and income group. For these adjusted comparisons, the statistical test compares the pair of race/ethnicity groups after accounting for any differences in the age, sex and income distributions between the race/ethnicity groups.

In Table 1, for the unadjusted "Below Poverty Level" and "At or Above Poverty Level" comparisons, the only explanatory variables are terms for each of the 10 race/ethnicity/income combinations (combinations of five race/ethnicity groups and two income groups). For example, in row 1, the p-value for "Below Poverty Level" compares White non-Hispanics below the poverty level with Black non-Hispanics below the poverty level. The same set of explanatory variables are used in Table 2 for the unadjusted comparisons between one race/ethnicity group below the poverty level and the same or another race/ethnicity group at or above the poverty level. The corresponding adjusted analyses include extra explanatory variables for sex, so that race/ethnicity/income groups are compared after accounting for any differences due to sex.

Additional comparisons are shown in Table 3. The AGAINST = "sex" unadjusted p-value compares the percentages for boys and girls. The adjusted p-value includes adjustment terms for income, and race/ethnicity in the model. The AGAINST = "income" unadjusted p-value compares the percentages for those below poverty level with those at or above poverty level. The adjusted p-value includes adjustment terms for sex, and race/ethnicity in the model. For more details on these statistical analyses, see the memorandum by Cohen (2010).[v]

[v] Cohen, J. 2010. *Selected statistical methods for testing for trends and comparing years or demographic groups in ACE NHIS and NHANES indicators.* Memorandum submitted to Dan Axelrad, EPA, 21 March, 2010.

Table 1. Statistical significance tests comparing the percentages of children ages 0 to 6 years with regular exposure to environmental tobacco smoke in the home, between pairs of race/ethnicity groups, for 2005.

			P-VALUES					
Variable	**RACE1**	**RACE2**	**All incomes**	**All incomes (adjusted for sex, income)**	**Below Poverty Level**	**Below Poverty Level (adjusted for sex)**	**At or Above Poverty Level**	**At or Above Poverty Level (adjusted for sex)**
ETS	White non-Hispanic	Black non-Hispanic	0.064	0.840	0.146	0.151	0.260	0.255
ETS	White non-Hispanic	Asian non-Hispanic	0.054	0.054	0.043	0.044	0.193	0.189
ETS	White non-Hispanic	Hispanic	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005
ETS	White non-Hispanic	Other	0.580	0.917	0.888	0.863	0.868	0.874
ETS	Black non-Hispanic	Asian non-Hispanic	0.014	0.071	0.088	0.090	0.097	0.093
ETS	Black non-Hispanic	Hispanic	< 0.0005	< 0.0005	0.003	0.003	< 0.0005	< 0.0005
ETS	Black non-Hispanic	Other	0.597	0.838	0.554	0.579	0.655	0.647
ETS	Asian non-Hispanic	Hispanic	0.793	0.760	0.324	0.331	0.443	0.449
ETS	Asian non-Hispanic	Other	0.044	0.073	0.075	0.079	0.228	0.225
ETS	Hispanic	Other	0.001	< 0.0005	0.022	0.023	0.003	0.003
ETS	Mexican	Puerto Rican	0.008	0.006	0.003	0.003	0.745	0.731

Table 2. Statistical significance tests comparing the percentages of children ages 0 to 6 years with regular exposure to environmental tobacco smoke in the home, between pairs of race/ethnicity/income groups at different income levels, for 2005.

			P-VALUES	
Variable	**RACEINC1**	**RACEINC2**	**Unadjusted**	**Adjusted (for sex)**
ETS	White non-Hispanic, < PL	White non-Hispanic, >= PL	< 0.0005	< 0.0005
ETS	White non-Hispanic, < PL	Black non-Hispanic, >= PL	< 0.0005	< 0.0005
ETS	White non-Hispanic, < PL	Asian non-Hispanic, >= PL	0.001	0.001
ETS	White non-Hispanic, < PL	Hispanic, >= PL	< 0.0005	< 0.0005
ETS	White non-Hispanic, < PL	Other, >= PL	0.001	0.001
ETS	Black non-Hispanic, < PL	White non-Hispanic, >= PL	< 0.0005	< 0.0005
ETS	Black non-Hispanic, < PL	Black non-Hispanic, >= PL	0.019	0.019
ETS	Black non-Hispanic, < PL	Asian non-Hispanic, >= PL	0.007	0.007
ETS	Black non-Hispanic, < PL	Hispanic, >= PL	< 0.0005	< 0.0005
ETS	Black non-Hispanic, < PL	Other, >= PL	0.047	0.045
ETS	Asian non-Hispanic, < PL	White non-Hispanic, >= PL	0.313	0.319
ETS	Asian non-Hispanic, < PL	Black non-Hispanic, >= PL	0.234	0.238
ETS	Asian non-Hispanic, < PL	Asian non-Hispanic, >= PL	0.709	0.722
ETS	Asian non-Hispanic, < PL	Hispanic, >= PL	0.966	0.976
ETS	Asian non-Hispanic, < PL	Other, >= PL	0.299	0.306

			P-VALUES	
Variable	**RACEINC1**	**RACEINC2**	**Unadjusted**	**Adjusted (for sex)**
ETS	Hispanic, < PL	White non-Hispanic, >= PL	0.929	0.924
ETS	Hispanic, < PL	Black non-Hispanic, >= PL	0.361	0.355
ETS	Hispanic, < PL	Asian non-Hispanic, >= PL	0.231	0.227
ETS	Hispanic, < PL	Hispanic, >= PL	< 0.0005	< 0.0005
ETS	Hispanic, < PL	Other, >= PL	0.846	0.848
ETS	Other, < PL	White non-Hispanic, >= PL	0.016	0.017
ETS	Other, < PL	Black non-Hispanic, >= PL	0.061	0.065
ETS	Other, < PL	Asian non-Hispanic, >= PL	0.009	0.009
ETS	Other, < PL	Hispanic, >= PL	< 0.0005	< 0.0005
ETS	Other, < PL	Other, >= PL	0.067	0.071
ETS	Mexican, < PL	Mexican, >= PL	0.044	0.045
ETS	Mexican, < PL	Puerto Rican, >= PL	0.449	0.460
ETS	Puerto Rican, < PL	Mexican, >= PL	< 0.0005	< 0.0005
ETS	Puerto Rican, < PL	Puerto Rican, >= PL	0.007	0.008

Table 3. Other statistical significance tests comparing the percentages of children ages 0 to 6 years with regular exposure to environmental tobacco smoke in the home, for 2005.

		P-VALUES	
Variable	**Against**	**Unadjusted**	**Adjusted***
ETS	sex	0.159	0.161
ETS	income	< 0.0005	< 0.0005

*For AGAINST = ”sex,” the p-values are adjusted for race/ethnicity and income.
For AGAINST = ”income,” the p-values are adjusted for sex and race/ethnicity.

Methods

Indicator

Dust1. Percentage of children ages 0 to 5 years living in homes with interior lead hazards, 1998-1999 and 2005-2006.

Summary

The United States Department of Housing and Urban Development (HUD) has conducted two nationally representative surveys of housing in the United States to assess children's potential household exposure to lead and other contaminants. The American Healthy Homes Survey (AHHS) was conducted from 2005–2006 to update the National Survey of Lead and Allergens in Housing (NSLAH), which was conducted from 1998–1999. AHHS also included measurements of arsenic, pesticides, and mold.

This indicator gives the percentages of children ages 0 to 5 years living in homes with interior lead hazards, either interior lead dust or interior deteriorated lead-based paint. Under the Lead Safe Housing Act, a significant lead-based paint hazard is the presence of deteriorating lead-based paint, lead-contaminated dust, or lead-contaminated soil above federal standards. For lead-contaminated dust, there are separate standards for dust on the floor and dust on windowsills. Floor dust samples should not have more than 40 micrograms of lead per square foot ($\mu g/ft^2$) and window dust samples should not have more than 250 $\mu g/ft^2$. Current federal health-based standards qualify a significantly deteriorated lead-based paint hazard as the deterioration of an area of lead-based paint greater than 20 square feet (exterior) and 2 square feet (interior) for large-surface items, such as walls and doors; or damage to more than 10% of the total surface area of small-surface components—such as windowsills, baseboards, and trim—with lead-based paint.

For each home, the NSLAH and AHHS surveys include information on the dust lead loadings of interior lead dust measured on surface wipes, and X-ray fluorescence measurements of lead in paint. The surveys also include survey weights and demographic information for all persons living in that home. For each home, the presence or absence of interior lead dust or interior deteriorated lead-based paint was determined. Percentages of children ages 0 to 5 years living in homes with interior lead hazards are calculated by combining the interior lead hazard indicators for each home with the numbers of children ages 0 to 5 years and the survey weights for each home in the survey. The survey weights are the numbers of U.S. homes represented by each home surveyed.

Data Summary

Indicator: Dust1. Percentage of children ages 0 to 5 years living in homes with interior lead hazards, 1998-1999 and 2005-2006.

Data	Prevalence of exposure in the home to interior lead hazards in children ages 0 to 5 years.	
Time Period	1998-1999 or 2005-2006.	
Years	1998-1999 (NSLAH)	2005-2006 (AHHS)
Homes with non-missing data	831	1,131
Homes with non-missing data and one or more children ages 0 to 5 years	184	206

Overview of Data Files

The following files are needed to calculate this indicator. The files were obtained directly from the U.S. Department of Housing and Urban Development (HUD).[vi]

- NSLAH: Derived data file blenplay.sd2, Resident file RES03_A.sd2, Jackknife weight file jknfac.dat. The blenplay.sd2 file is a SAS dataset file with home measurement data including the housing unit ID code (HUID), interior lead dust indicator (LD99INT), interior deteriorated lead-based paint indicator (DLP99INT), home survey weight (FINDUWT), and the 99 jackknife survey weights (FINDUW1, FINDUW2, … , FINDUW99). The RES03_A.sd2 file is a SAS dataset file with resident demographic information including the HUID and the age (Q25C) of all residents. The jknfac.dat file is an ASCII file that lists the 99 jackknife factors used for estimating uncertainties.

- AHHS: Laboratory wipe data file wipe_lab.sas7bdat, X-ray fluorescence data file xrf_lbp.sas7bdat, People file people_tab.sas7bdat, Weights file weights.sas7bdat, Jackknife weight file jknfactors.txt. The wipe_lab.sas7bdat file is a SAS dataset file with surface wipe home measurement data including the dwelling unit ID code (DUID), the location code (LOCATION), and the dust lead loading (LEAD_RESULT_BYAREA). The xrf_lbp.sas7bdat file is a SAS dataset file with X-ray fluorescence data on paint including the DUID, lead level (PBL), room type (ROOMTYPE), and level of deterioration (DET). The people_tab.sas7bdat file is a SAS dataset file with resident demographic information including the DUID and the age (P38C) of all residents. The weights.sas7bdat file is a SAS dataset file with the home survey weight (RPL000), and the 116 jackknife survey weights (RPL001, RPL002, … , RPL116). The jknfactors.txt file is an ASCII file that lists the 116 jackknife factors used for estimating uncertainties.

National Survey of Lead and Allergens in Housing (NSLAH)

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In 1998-1999, the U.S. Department of Housing and Urban Development (HUD) and other sponsors conducted the National Survey of Lead and Allergens in Housing (NSLAH), a U.S. national survey of lead dust, lead-based paint, lead in soil, and other contaminants in homes. (An augmentation of the soil sampling was carried out in 2000.) The survey included the determinations of the presence or absence of interior lead dust and the presence or absence of interior deteriorated lead-based paint defined as follows:

- Interior Lead Dust, LD99INT: Are there one or more floor wipe samples taken inside the home that have a dust lead loading of 40 $\mu g/ft^2$ or greater? Are there one or more windowsill wipe samples taken inside the home that have a dust lead loading of 250 $\mu g/ft^2$ or greater? These criteria are from the Lead Safe Housing Rule of 1999. If the answer to one or both questions is positive, then LD99INT = 1, indicating the presence of interior lead dust, otherwise LD99INT = 0, indicating the absence of interior lead dust.

- Interior Deteriorated Lead-Based Paint, DLP99INT: Are there one or more X-ray fluorescence readings taken inside the home that have a reading of 1.0 mg/ft^2 of lead or greater and have a non-zero measured percentage of deterioration? This criterion is from the Lead Safe Housing Rule of 1999. If the answer to this question is positive, then DLP99INT = 1, indicating the presence of interior deteriorated lead-based paint, otherwise DLP99INT = 0, indicating the absence of interior deteriorated lead-based paint.

For these analyses, we also computed a lead hazard indicator for the presence or absence of either interior lead dust or interior deteriorated lead-based paint:

- Either Interior Lead Dust or Interior Deteriorated Lead-Based Paint: Either the home has interior lead dust, or the home has interior deteriorated lead-based paint, or both.

The NSLAH used a complex multi-stage, stratified, clustered sampling design to select the homes. The data include home survey weights to adjust for the sampling design. The statistical analyses used the home survey weights (FINDUWT) to readjust the response indicators to represent the total national population of homes. The statistical analysis also adjusted the data by weighting each home by the number of resident children ages 0 to 5 years, using the resident age data for that home. Using both the survey weight and the number of children to adjust the data readjusts the response indicators to represent the total national population of children ages 0 to 5 years.

American Healthy Homes Survey (AHHS)

In 2005-2006, the U.S. Department of Housing and Urban Development (HUD) and other sponsors conducted the American Healthy Homes Survey (AHHS), a U.S. national survey of lead dust, lead-based paint, lead in soil, and other contaminants in homes. The survey included the determinations of the presence or absence of interior lead dust and the presence or absence of interior deteriorated lead-based paint defined as follows:

- Interior Lead Dust: Are there one or more floor wipe samples taken inside the home that have a dust lead loading of 40 µg/ft^2 or greater? This criterion holds if LOCATION = "F" and LEAD_RESULT_BYAREA ≥ 40 are both true for one or more wipe samples. Are there one or more windowsill wipe samples taken inside the home that have a dust lead loading of 250 µg/ft^2 or greater? This criterion holds if LOCATION = "WS" and LEAD_RESULT_BYAREA ≥ 250 are both true for one or more wipe samples. These criteria are from the Lead Safe Housing Rule of 1999. If the answer to one or both questions is positive, then interior lead dust is present in the home. Otherwise interior lead dust is absent.

- Interior Deteriorated Lead-Based Paint: Are there one or more X-ray fluorescence readings taken inside the home that have a reading of 1.0 mg/cm^2 of lead or greater and have a non-zero measured percentage of deterioration? This criterion holds if ROOMTYPE ≠ "EXT" (external), PBL ≥ 1, and DET ≠ "0%" all apply for one or more readings. This criterion is from the Lead Safe Housing Rule of 1999. If the answer to this question is positive, then interior deteriorated lead-based paint is present in the home. Otherwise interior deteriorated lead-based paint is absent.

- Either Interior Lead Dust or Interior Deteriorated Lead-Based Paint: Either the home has interior lead dust, or the home has interior deteriorated lead-based paint, or both.

The AHHS used a complex multi-stage, stratified, clustered sampling design to select the homes. The data includes home survey weights to adjust for the sampling design. The statistical analyses used the home survey weights (RPL000) to readjust the response indicators to represent the total national population of homes. The statistical analysis also adjusted the data by weighting each home by the number of resident children ages 0 to 5 years, using the resident age data for that home. Using both the survey weight and the number of children to adjust the data readjusts the response indicators to represent the total national population of children ages 0 to 5 years.

Calculation of Indicator

Indicator Dust1 is the percentage of children ages 0 to 5 years living in homes with interior lead hazards. The percentages were computed for the following interior lead hazards:

- Interior Lead Dust
- Interior Deteriorated Lead-Based Paint
- Either Interior Lead Dust or Interior Deteriorated Lead-Based Paint

For each home surveyed in NSLAH or AHHS, the presence or absence of an interior lead hazard was determined as described above.

To illustrate the calculations, we will apply them to the NSLAH surveyed homes in 1998-1999 for the interior lead hazard of Interior Lead Dust. A Yes response for a home is when interior lead dust is present in the home. A No response for a home is when interior lead dust is absent in the home.

Each sampled home has an associated home survey weight that estimates the national number of homes (in thousands) represented by that sampled home. For example, the first response was No with a survey weight of 160, and so represents 160 thousand homes. There were zero (0) children ages 0 to 5 years residing at that home. Thus the first home represents 160 × 0 = 0 thousand children ages 0 to 5 years. A second home had a No response with a survey weight of 245, and so represents 245 thousand homes. There was 1 child ages 0 to 5 years residing at that home. Thus the second home represents 245 × 1 = 245 thousand children ages 0 to 5 years. A third home had a Yes response with a survey weight of 188, and so represents 188 thousand homes. There were 2 children ages 0 to 5 years residing at that home. Thus the third home represents 188 × 2 = 376 thousand children ages 0 to 5 years. The total of the survey weights for the sampled homes equals 95,688, so that the data represent a total of 95,688 thousand U.S. homes in 1998-1999.

To calculate the proportion of children ages 0 to 5 years living in homes with interior lead dust, we can use the survey weights to expand the data to the total U.S. population of 95,688 thousand U.S. homes in 1998-1999. The first sampled home represents 160 thousand homes and 0 children ages 0 to 5 years. The second home represents 245 thousand homes and 245 thousand children ages 0 to 5 years. The third home represents 188 thousand homes and 376 thousand children ages 0 to 5 years. The entire sample of homes represents a total of 95,688 thousand U.S. homes and 22,638 thousand children ages 0 to 5 years. We have 0 children with Yes responses from the first home, 0 children with Yes responses from the second home, 376 thousand children with Yes responses from the third home, and so on. Of the 22,638 thousand children ages 0 to 5 years, there are a total of 3,661 thousand children with Yes responses. Thus 3,661 thousand of the 22,638 thousand children ages 0 to 5 years were living in homes with interior lead dust, giving a percentage of 16.2% (3,661/22,638).

In this calculation we included sampled homes with zero children ages 0 to 5 years, which each contribute 0 children with Yes responses and 0 children with No responses. Exactly the same calculation could be done using only the sampled homes with one or more children ages 0 to 5 years and the same result would be obtained.

<u>Equations</u>

The following equations give the mathematical calculations for the example of interior lead dust. Let w(i) denote the survey weight for the i'th surveyed home. Let c(i) denote the number of children ages 0 to 5 years for the i'th surveyed home. Let the response indicator d(i) = 1 if the i'th surveyed home had a Yes response and let d(i) = 0 if the i'th surveyed home had a No response.

1. Sum (over i) all the survey weights multiplied by the number of children ages 0 to 5 years to get the total number of children C (in thousands):

$$C = \Sigma\, w(i) \times c(i)$$

2. Sum (over i) all the survey weights multiplied by the number of children ages 0 to 5 years and multiplied by the response indicators to get D, the total number of children ages 0 to 5 years with a Yes response (in thousands):

$$D = \Sigma\, w(i) \times c(i) \times d(i)$$

3. Divide D by C to get the percentage of children living in homes with interior lead dust:

$$\text{Percentage} = (D / C) \times 100\%$$

Relative Standard Error

The uncertainties of the percentages were calculated using SUDAAN® (Research Triangle Institute, Research Triangle Park, NC 27709) statistical survey software. SUDAAN was used to calculate the estimated percentages and the standard errors of the estimated percentages. The standard error is the estimated standard deviation of the percentage, and this depends upon the survey design. For this purpose, the data sets from NSLAH and AHHS each include sets of jackknife weights and jackknife factors. For NSLAH, the data set was subdivided into 99 “variance units,” each consisting of one or more primary sampling units or pseudo-primary sampling units. To use the jackknife method, one variance unit at a time is dropped from the sample and the weights of the remaining variance units are multiplied by a reweighting factor to get a set of jackknife weights for that replicate. Thus you get one replicate for each variance unit that gets dropped. The jackknife weights are used in place of the original survey weights to get 99 estimated percentages, one for each replicate. The 99 jackknife factors are used together with the original estimated percentage and the 99 jackknife estimated percentages to estimate the variance and standard error of the percentage using a standard formula. For AHHS the same approach was used with 116 replicates.

The relative error is the standard error divided by the estimated percentage:

$$\text{Relative Error (\%)} = [\text{Standard Error (Percentage)} / \text{Percentage}] \times 100\%$$

Percentages with a relative error less than 30% were treated as being reliable and were tabulated. Percentages with a relative error greater than or equal to 30% but less than 40% were treated as being unstable; these values were tabulated but were flagged to be interpreted with caution. Percentages with a relative error greater than or equal to 40% or missing were treated as being unreliable; these values were not tabulated and were flagged as having a large uncertainty. For the NSLAH and AHHS data, the percentages for the indicator Dust 1 all had relative errors less than 30%.

Questions and Comments

Questions regarding these methods, and suggestions to improve the description of the methods, are welcome. Please use the “Contact Us” link at the bottom of any page in the America’s Children and the Environment website.

Statistical Comparisons

Statistical analyses of the percentages of children living in homes with interior lead hazards were used to determine whether the differences between the NSLAH and AHHS percentages were statistically significant, which is the same as determining whether the trend between the NSLAH and AHHS surveys was statistically significant. For this calculation, we used the estimated percentages and their standard errors, calculated as described above in the subsection "Relative Standard Error." A z-statistic was computed by dividing the difference between the percentages by the estimated standard error of the difference:

$$z = [\text{percentage (NSLAH)} - \text{percentage (AHHS)}\} \; / \; \sqrt{\{\text{standard error (NSLAH)}^2 + \text{standard error (AHHS)}^2]}$$

The p-value for z is calculated using the standard normal distribution as twice the probability that a standard normal variate exceeds |z|. A p-value at or below 0.05 implies that the difference is statistically significant at the 5% significance level.[vii] No adjustment is made for multiple comparisons.

The p-values are tabulated in Table 1.

Table 1. Statistical significance tests comparing the percentages of children ages 0 to 5 years living in homes with interior lead hazards, between the NSLAH (1998-1999) and AHHS (2005-2006).

Interior Lead Hazard	**P-value**
Interior lead dust	0.396
Interior deteriorated lead-based paint	0.739
Either interior lead dust or interior deteriorated lead-based paint	0.157

[vii] For this method it is assumed that the two surveys were statistically independent, that the differences are approximately normally distributed, and that the uncertainties in the standard errors can be treated as negligible. An adjustment for the degrees of freedom was not applied since the NSLAH survey had 52 degrees of freedom for estimating the standard error and the AHHS survey had 61 degrees of freedom.