SMOKE-FILLED ROOMS:
SMOKING IN CHILDREN'S HOMES
AND STATE SMOKEFREE AIR LEGISLATION

By

Kathleen A. Newton

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CERTIFICATE OF APPROVAL

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This is to certify that the Master's thesis of

Kathleen A. Newton

has been approved

William Lambert, PhD
Mentor/Advisor

Dongseok Choi, PhD
Member

Christina Bethell, PhD, MBA, MPH
Member

Eun Sul Lee, PhD
Member

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LIST OF ABBREVIATIONS

AAP .....American Academy of Pediatrics
AHRQ .....Agency for Healthcare Research and Quality (U.S. DHHS)
ALA .....American Lung Association
ANRF .....American Nonsmokers' Rights Foundation
Cal/EPA ..California Environmental Protection Agency
CAHMI ...Child and Adolescent Health Measurement Initiative
CASRO ...Council of American Survey Research Organizations
CATI .....Computer Assisted Telephone Interview
CDC .....Centers for Disease Control and Prevention (U.S. DHHS)
DHHS .....U.S. Department of Health and Human Services
DRC .....Data Resource Center for Child and Adolescent Health, a project of CAHMI
EPA .....U.S. Environmental Protection Agency
ERB .....Ethics Review Board (NCHS)
ETS .....Environmental Tobacco Smoke
FPL .....Federal Poverty Level guidelines based on income and number in household
HRSA .....Health Resources and Services Administration (U.S. DHHS)
IRB .....Institutional Review Board
MCHB .....Maternal and Child Health Bureau (HRSA)
MEPS .....Medical Expenditure Panel Survey (AHQR)
NCHS .....National Center for Health Statistics (CDC)
NCI .....National Cancer Institute (NIH)
ng/ml .....nanograms per milliliter
NH .....Non-Hispanic
NHANES National Health and Nutrition Examination Survey (NCHS)
NHIS .....National Health Interview Survey (NCHS)
NIH .....National Institutes of Health (U.S. DHHS)
NIS .....National Immunization Survey (NCHS-SLAITS)
NORC .....National Opinion Research Center (University of Chicago)
NSCH .....National Survey of Children's Health (NCHS-SLAITS)
OHSU .....Oregon Health & Science University
RDD .....Random Digit Dialing
SAS .....Statistical analysis software
SCLD .....State Cancer Legislative Database (SCLD)
SHS .....Secondhand Smoke
SLAITS ...State and Local Area Integrated Telephone Survey (NCHS)
SLATI .....State Legislated Actions on Tobacco Issues (ALA)
SPSS .....Statistical analysis software
TUS-CPS..Tobacco Use Supplement of the Current Population Survey (U.S. Census Bureau and Bureau of Labor Statistics)

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ABSTRACT

Objectives. (1) Examine the prevalence of in-home exposure to secondhand tobacco smoke (SHS) among U.S. children overall and within demographic subgroups. (2) Investigate the relationship between state-level smokefree air legislation and prevalence of smokefree homes among U.S. children whose households include smokers.

Methods. We used data from the 2007 National Survey of Children's Health, supplemented with state-level adult smoking prevalence and rating of state smokefree air legislation. Prevalence estimates were derived from 91,970 parent respondents for children age 0-17 years in all 50 states and the District of Columbia, and weighted to reflect characteristics of the U.S. child population. Logistic regression analysis was conducted for a subset of 22,112 children living in households with smokers. Legislative provisions in effect prior to NSCH data collection were categorized as "Strong", "Adequate" or "Inadequate" based on scores reported in the 2006 edition of "State of Tobacco Control" published annually by the American Lung Association.

Results. In the U.S. over 19 million children under 18 years of age live in households in which someone uses cigarettes, cigars, or pipe tobacco, 26.2% of all children (95% CI: 25.5-26.9). An estimated 5.5 million of these children are exposed to SHS from smoking that occurs inside their homes: 7.6% of all children (95% CI: 7.2-8.0), and 29.0% of children who live with smokers (95% CI: 27.6-30.3). Among children living with smokers, those whose households prohibit smoking inside the home are more likely to be young (age 0-5 years, OR 2.9, 95% CI 2.4-3) and Hispanic (OR 2.1, 95% CI 1.4-3.0). However, inverse associations were observed among children whose household income

was below (OR 0.40, 95% CI 0.32-0.50) or just above the federal poverty line (OR 0.44, 95% CI 0.35-0.54), and children living with single mothers (OR 0.61, 95% CI 0.51-0.73) or in "Other" family types (OR 0.50, 95% CI 0.39-0.66). Among Black and Other Race children living in states with Adequate smokefree air laws the odds of having a smokefree home are much lower compared to those who live in states with Inadequate legislation (OR 0.48, CI 0.32-0.71, and OR 0.43, CI 0.21-0.86, respectively). Associations between Strong and Adequate state smokefree air legislation and prevalence of smokefree homes among children living with smokers vary according to smoking prevalence of the state in which the child resides.

Conclusions. In addition to its direct effects on SHS in public venues and private workplaces, Adequate or Strong state-level smokefree air legislation is associated with higher prevalence of smokefree home environments for children living with smokers. Such legislation may be most effective in the context of a comprehensive and multi-faceted approach to reducing smoking prevalence among parents and increasing the prevalence of smokefree home environments for children.

INTRODUCTION

Secondhand tobacco smoke

Secondhand smoke (SHS) is a combination of sidestream smoke from the burning of tobacco, paper, and additives in a cigarette, cigar, or pipe, and mainstream smoke exhaled by a smoker. The complex mixture of gases and particles in SHS contains at least 250 toxic chemicals, including more than 50 known cancer-causing substances (National Toxicology Program, 2005). SHS is classified by the U.S. Environmental Protection Agency (EPA) as a Class A carcinogen (U.S. EPA, 1992).

Passive or involuntary smoking occurs when a non-smoker inhales secondhand tobacco smoke. Over the years countless studies have documented the adverse health consequences of exposure to secondhand smoke. The 2006 Surgeon General's Report on involuntary exposure to tobacco smoke concludes that "Secondhand smoke causes premature death and disease in children and in adults who do not smoke" (U.S. Department of Health and Human Services, 2006). The report emphasizes that there is no known safe level of exposure to secondhand tobacco smoke.

Among adults, exposure to SHS causes both immediate and long-term cardiovascular problems, coronary heart disease, and lung cancer. It has been shown to increase the risk of heart disease and lung cancer by up to 30% among nonsmoking adults who are exposed to it at home or at work (U.S. Department of Health and Human Services, 2006). A comprehensive study conducted by the California Environmental Protection Agency (CAL/EPA) and published in 2005 estimates that in the U.S. as many as 50,000 excess

deaths occur every year as a result of exposure to secondhand tobacco smoke (California Environmental Protection Agency, 2005).

Health consequences for children

After decades of research on the health effects of SHS, there is no longer any doubt that any amount of exposure is harmful to the health of children as well as adults (U.S. Department of Health and Human Services, 2006; Best D; American Academy of Pediatrics, Committee on Environmental Health, Committee on Adolescence, and Committee on Native American Child Health, 2009). According to the 2005 Cal/EPA report, annual attributable risks associated with SHS exposure among children nationwide include 430 excess deaths from Sudden Infant Death Syndrome (SIDS), 96,400 excess low birth weight and pre-term births, 202,300 excess episodes of asthma, and 790,000 excess visits for otitis media (Cal/EPA, 2005).

The health effects of exposure to toxins from SHS during critical developmental periods can be immediate or delayed, transitory or lifelong. Maternal smoking during pregnancy increases the risk of miscarriage, birth complications, low birth weight, and some physical abnormalities (Windham, Von Behren, Waller, & Fenster, 1999; Pollack, Lantz, & Frohna, 2000; Salihu, Aliyu, Pierre-Louis, & Alexander, 2003). Decreased initiation and duration of breastfeeding have been linked to maternal smoking (Liu, Rosenberg, & Sandoval, 2006).

Among non-smoking mothers, exposure to SHS during pregnancy has been linked with serious fetal health problems. A study of fetal death, preterm delivery, and term-low birth weight among non-smoking in pregnant women estimates that serum cotinine levels

of 0.05ng/ml or more accounted for 12 percent of adverse fetal outcomes in the study population (Kharrazi, DeLorenze, Kaufman, et al, 2004).

Exposure to SHS has been established as a causal factor in numerous health conditions in infancy and childhood (Mannino, Moorman, Kingsley, Rose, & Repace, 2001). These include SIDS (DiFranza & Lew, 1995; Schoendorf & Kiely, 1992) in particular, as well as elevated risk of infant death from all causes (Salihu, Aliyu, Pierre-Louis, & Alexander, 2003). Lower respiratory infection, asthma and other respiratory conditions (Gilliland, Berhane, McConnell, et al., 2000), otitis media (Lieu & Feinstein, 2002), difficulty feeding and sleeping, and poor growth are more prevalent among infants exposed to SHS (Best D; American Academy of Pediatrics, Committee on Environmental Health, Committee on Adolescence, and Committee on Native American Child Health, 2009).

The American Academy of Pediatrics (AAP) cites links between SHS and childhood asthma, SIDS, middle ear disease, pneumonia, coughing, upper and lower respiratory infection, lower high-density lipoprotein cholesterol levels, and coronary artery disease (American Academy of Pediatrics, 2001). Children exposed to SHS miss more school (Mannino, Moorman, Kingsley, Rose, & Repace, 2001), and have more frequent medical and emergency room visits, hospitalizations, and higher health costs than other children (Gergen, 2001; Hill & Liang, 2008).

There is a growing body of evidence that SHS exposure during infancy and childhood has latent health consequences as well, including elevated cholesterol levels in young adults (Jaddoe, et al., 2008), adult asthma and respiratory symptoms (Skorge, Eagan, Eide, Gulsvik, & Bakke, 2005), hypertension (Xiao, Huang, Lawrence, Yang, & Zhang,

2007), adult onset of some forms of cancer (Sandler, Everson, Wilcox, & Browder, 1985), and indications of an association with early onset of menopause (Strohsnitter, Hatch, Hyer, et al., 2008).

Childhood exposure pathways

Children's vulnerability to the hazards of SHS is magnified by several factors peculiar to childhood. Because they breathe more air in proportion to their body weight, children receive higher doses of toxins than do adults with the same amount of exposure (Willers, Skarping, Daling, & Skerfing, 1995). Children's developing respiratory, neurological, and digestive systems are more easily harmed by environmental toxins. In the months before and after birth, children have additional pathways of exposure through the placenta and breast milk and they have many more years of life ahead during which latent consequences of early SHS exposure could appear.

Through infancy and beyond, children's living environments are controlled to a large extent by parents or other caregivers. Unlike adults, children seldom have the option to leave their home to avoid secondhand smoke. Although SHS exposure can occur anywhere, children on the whole spend more time in their own homes than anywhere else, and more time with their parents and other family members than with anyone else. It's not surprising, then, that home and family figure prominently in children's exposure to SHS (Matt, Quintana, Hovell, et al., 2004).

The most significant source of SHS exposure among children is their own homes. In spite of widespread public awareness of the serious health consequences of SHS (McMillen, Winickoff, Klein, & Weitzman, 2003), millions of children in the U.S. continue to be exposed at home on a daily basis.

Prevalence of secondhand smoke exposure

In the years following publication of the Surgeon General's 1986 report "The Health Consequences of Involuntary Smoking," the prevalence of both active and passive smoking in the United States has decreased dramatically (U.S. Department of Health and Human Services, 2006). By the time the National Health and Nutrition Examination Survey, the National Health Interview Survey, and the Current Population Survey began collecting data on childhood SHS exposure in the early 1990's, smoking in the U.S. was already beginning a steep decline (Goodwin, 2007). Between 1988 and 2002, mean serum cotinine concentrations measured by the National Health and Nutrition Examination Survey (NHANES) in U.S. nonsmokers age four and older declined by 70 percent (Pirkle, Bernert, Caudill, Sosnoff, & Pechacek, 2006). According to this study, the U.S. population prevalence of serum cotinine concentration > 0.05ng/ml dropped from 88 percent in 1988-1991 to 80 percent in 1991-1994, and continued to fall to 51 percent in 1999-2000 and 43 percent in 2001-2002. A more recent study, also from NHANES, reveals a less steady decline from the 1999-2000 through 2007-2008, when the NSCH was in the field. That survey estimates prevalence of serum cotinine concentration greater than 0.05ng/ml in the U.S. population at 40 percent in 2007-2008 (Centers for Disease Control and Prevention, 2010). Both of these studies observe that widespread implementation of laws restricting smoking in public places has been instrumental in reducing nonsmokers' exposure to SHS.

The NHANES studies further note that while prevalence of SHS biomarkers decreased across all groups, the decrease among children under the age of 12 lags well behind that of other age groups, remaining about 10-15 percent higher than the overall

prevalence. A study based on the 2003-2006 NHANES examines serum cotinine concentrations among children age 3-19 according to the presence or absence of reported smoking in the child's home, and concludes that among children living in smokefree homes SHS exposure has decreased dramatically since the 1988-1994 NHANES studies. However, among children with in-home exposure to SHS in 2003-2006, mean serum cotinine concentration was nearly identical to the same group in the earlier study, leading the investigators to conclude that the benefits of smokefree air laws had not yet extended to children living with smokers (Marano, Schober, Brody, & Zhang, 2009).

It is not coincidental that a rise in the number of homes with rules banning smoking has accompanied the decrease in smoking and exposure to secondhand tobacco smoke. A 2004 analysis of households with children under 18 years of age in the 1992 and 2000 National Health Interview Surveys conducted by the National Center for Health Statistics showed a much steeper decline of children's in-home SHS exposure, compared to the decline in adult smoking prevalence (Soliman, Pollack, & Warner, 2004), occurring at the same time as the steepest drops in SHS exposure. Similar results were noted in a study comparing results from three rounds of the Tobacco Use Supplement of the Current Population Survey (TUS-CPS) administered by the U.S. Census Bureau (Centers for Disease Control and Prevention, 2007), which estimates a two-thirds increase in overall prevalence of smokefree homes in the U.S. between 1992-3 and 2003. The proportion of households with total bans on smoking has increased over the years among households with and without smokers, but the prevalence of smoking bans in households with smokers is about 40 percentage points lower than among nonsmoking households (Cheng, Glantz, & Lightwood, 2011).

Recent estimates of the prevalence of SHS exposure among children vary depending on the measure and how SHS is defined. Results from the 2007-2008 NHANES indicate that 50.2 percent of children between 3 and 19 years of age have serum cotinine concentration at or above the exposure threshold of 0.05ng/ml (Centers for Disease Control and Prevention, 2010). The prevalence of exposure among younger children (53.6%, age 3-11 years) is slightly higher than among older children and youth (46.5%, age 12-19 years). The same study finds that 18.2 percent of children age 3-11 and 17.1 percent of 12-19 year olds live with someone who smokes inside the home. Of these children, 98.3 percent have serum cotinine of 0.05 or higher, compared to 39.9 percent of those living in smokefree homes.

Household smoking behaviors and rules

According to a study based on the 2006/2007 Tobacco Use Supplement for the Current Population Survey (TUS-CPS) 83.9 percent of parents in the U.S. prohibit smoking inside their homes (Hawkins & Berkman, 2011). Households with smokers are much more likely to permit smoking inside the home (44.2%) than non-smoking households (6.4%). Similar results were reported by Mills et al, who found that 50.0 percent of households with both children and smokers were smokefree (Mills, White, Pierce, & Messer, 2011).

In a nationwide survey conducted in 2008, 17.6 percent of parents reported no rules against smoking inside the home, but only 8.6 percent indicated that their children were exposed to SHS at home within the previous seven days (McMillen, Klein, Tanski, Winickoff, & Hill, 2009). This study also found that 44.7 percent of parents who smoke allow smoking in the home, compared to 10.7 percent of non-smoking parents.

Factors associated with smoking in children's homes

Not unexpectedly, presence of a smoker in children's households is highly correlated with in-home SHS exposure. A recent study found that 94 percent of non-smoking households with children had no-smoking rules, compared to 56 percent of households with children and smokers (Hawkins & Berkman, 2011). Similar results were reported from an earlier study, which found that 85 percent of households with children and smokers permit smoking inside the home (Schuster, Franke, & Pham, 2002). Among adult smokers in households with children, the presence of other adults who do not smoke is a predictor of having a smokefree home (Borland, et al., 2006). Among Hispanic women with 2-12 year old children in the southwestern U.S., 91 percent of nonsmokers report a complete household ban on smoking, compared to 63 percent of those who are smokers (Gonzales, Malcoe, Kegler, & Espinoza, 2006).

Younger children are more likely than older children to have smokefree living environment. A study based on results from the 2006/07 Tobacco Use Supplement to the Current Population Survey (TUS-CPS) reports that 84 percent of parents with 0-5 year old children do not allow smoking inside the home, compared to 82 percent of those whose children are older (Hawkins & Berkman, 2011). Data from the 2000 NHIS indicate an association between the age of the youngest child and the likelihood of regular smoking in the household. Households with younger children are much more likely to ban smoking inside the home than households with older children and teenagers (Schuster, Franke, & Pham, 2002). A study of smoking among adult women found that having young children increases the risk of smoking among low income White women,

while Non-white women are less likely to smoke if they have young children (Jun, Subramanian, Gortmaker, & Kawachi, 2004).

Race, ethnicity and immigrant status are related to parental smoking and SHS exposure among children, independently and in concert with each other. Hispanic ethnicity is consistently associated with lower risk of SHS exposure, when compared to other groups. The risk among Mexican American and Hispanic children is considerably lower than among other groups (Mannino, Moorman, Kingsley, Rose, & Repace, 2001; Soliman, Pollack, & Warner, 2004). Children of Hispanic women in the southwest are more likely to live in smokefree homes if their mother was born in Mexico, than if she was born in the U.S. (Gonzales, Malcoe, Kegler, & Espinoza, 2006).

Non-Hispanic children who are African American are more likely to be exposed to SHS (Mills, White, Pierce, & Messer, 2011). Results from NHANES surveys indicate that the reduction in serum cotinine levels observed among other groups in 1988-1991 and 1999-2002 did not occur among Black nonsmokers (Pirkle, Bernert, Caudill, Sosnoff, & Pechacek, 2006). Smoking and secondhand smoke exposure are more common among those with less education and in low-income households (Binns, O'Neil, Benuck, Ariza, & Pediatric Practice Research Group, 2009; Schuster, Franke, & Pham, 2002).

Family type and structure were associated with SHS outcomes in some studies. Living in a household with adults other than the child's parents is associated with elevated risk of smoking in children's homes (King, et al., 2009). Single parent families may respond differently than families with two parents because of social norms and simple logistics of having only one adult in the household.

Social norms associated with adult smoking prevalence are related to the prevalence of household smoking bans (Mills, White, Pierce, & Messer, 2011; Binns, O'Neil, Benuck, Ariza, & Pediatric Practice Research Group, 2009). Attitudes and knowledge about the health impact of secondhand smoke also play a role in parents' smoking behavior in the home (McMillen, Winickoff, Klein, & Weitzman, 2003).

Smokefree homes protect children

In an ideal world, the best way to protect children from SHS is for parents to quit smoking altogether, but it is not always possible for parents to quit. However, complete household smoking bans have been shown to significantly reduce children's exposure (Pyle, Haddock, Hymowitz, Schwab, & Meshberg, 2005) and may also support cessation efforts of parents. Addressing in-home exposure by parents is a reachable intermediary goal when parents or other household members want to protect children but are not ready or able to quit smoking themselves.

In addition to protecting children from SHS, smokefree homes encourage smokers to quit and support them in remaining smokefree. Focus on the home environment addresses the most important environment in children's lives and activates parents' motivation to protect children from SHS outside the home. Growing up smokefree reduces the chances children will start smoking during adolescence.

Smokefree air legislation

Public awareness of the danger of passive smoking sparked a movement to ban smoking in public places. Many of these initiatives were conceived in local areas during the 1990's. Over time, state governments took notice and began enacting statewide clean indoor air laws (American Lung Association, 2006). California and New York were

among the first states to implemented comprehensive tobacco control measures and both became models for much of the state legislation that has been enacted since then. Based on research from these and other efforts, the current "gold standard" for public protection of nonsmokers from SHS is statewide prohibition of smoking in three main venues: public and private workplaces, restaurants, and bars. While these three venues form the foundation of smokefree public policy, the list of other public places covered by smokefree air legislation grew to include schools and day care facilities, recreational and cultural facilities, and grocery and retail stores, in some states by 2007.

The Centers for Disease Control and Prevention, American Lung Association, American Cancer Society and several other groups created databases to track state and local smokefree air legislation, policies, and litigation. Currently there are three major national databases that track state tobacco control legislation and policy in states and local jurisdictions (Farrelly, 2009). The National Cancer Institute (NCI) created a comprehensive online resource, the State Cancer Legislative Database (SCLD), a broad-based online interactive database with information on numerous cancer-related topics, including smokefree air legislation (National Cancer Institute, 2010). Another group, the American Nonsmokers' Rights Foundation (ANRF), maintains an extensive database with local and state measures, enactment and implementation dates, and estimates of the percentage of population covered by smokefree legislation in local jurisdictions, states, and nationwide. The focus of the ANRF Local Ordinance Database is on smokefree laws covering workplaces, restaurants, freestanding bars, and gaming venues (American Nonsmokers Rights Foundation, 2012). The third database is the State Legislated Actions on Tobacco Use (SLATI), provided by the American Lung Association (ALA)

(American Lung Association, 2011). Information for the ALA's annual State of Tobacco Control report is obtained from this database (American Lung Association, 2006).

Impact on smoking-related health and health behaviors

There is considerable evidence that smokefree air legislation is associated with lower prevalence and intensity of smoking among adults and per capita cigarette consumption (Levy, Chaloupka, & Gitchell, 2004; Farkas, Gilpin, Distefan, & Pierce, 1999). A recent study of smoking prevalence among adults in Fayette County, Kentucky, found that after implementation of smokefree air laws smoking rates dropped 32 percent (Hahn, et al., 2008). Workplace SHS reductions have also been observed (McMullen, Brownson, Luke, & Chriqui, 2005). Studies of youth demonstrate that strong smokefree air legislation promotes lower prevalence, later uptake, and lower levels of tobacco use (McMullen, Brownson, Luke, & Chriqui, 2005; Farkas, Gilpin, White, & Pierce, 2000).

Studies in Europe and Australia have demonstrated that smokefree air legislation is associated with higher prevalence of voluntary smokefree policies in homes (Akhtar, Haw, Currie, Zachary, & Currie, 2009; Borland, et al., 2006). A study of data from the Tobacco Use Supplement of the Current Population Survey (TUS-CPS) compares the prevalence of voluntary home smoking bans in 2007 among households in counties with restrictions on workplace or restaurant smoking that cover all, part, or none of the county (Cheng, Glantz, & Lightwood, 2011). The authors found that 61 percent of adults living in counties with complete coverage have no smoking rules in their households, compared to 53 percent of those living in counties with no coverage. They conclude that living in a county with complete smokefree coverage is associated with higher likelihood of having smokefree home rules among both smokers and non-smokers.

Research questions and specific aims

The body of knowledge concerning the health effects of exposure to secondhand tobacco smoke, its mechanisms, and effective tobacco control strategies has grown tremendously over the past three decades. Yet much remains to be discovered, particularly with respect to children. Although government can directly impact personal behavior in public places, influencing health behaviors in private homes requires a different approach, supported by information about how and why decisions about secondhand smoke in children's home are or could be influenced.

Of the dozens of recent population-based studies of SHS exposure and home smoking bans among children, only a few specifically address the subpopulation of children living in households with smokers. In view of the lower prevalence of home smoking bans among households with smokers, we are compelled to focus additional effort on this population. Two questions form the basis for the current study:

1. How prevalent is parent-reported SHS exposure among children in the U.S.?
2. Is the risk of SHS exposure among children living in smoking households related to the presence of Strong smokefree air legislation, and how does this relationship vary across demographic subgroups?

We explore these questions with data from the 2007 National Survey of Children's Health, supplemented with state-level data from other sources. The National Survey of Children's Health is a population-based source of information on the health and health behaviors of children in the United States. Its design permits both state and national level analysis, and weighting of results to represent the overall population. The content is broad, and includes questions about household smoking behaviors. The NSCH affords a

much-needed new perspective capable of enriching the ongoing study of tobacco-related health and public policy issues with new information as well as results comparable to information collected in other national surveys.

For this study our specific aims are threefold:

1) *Prevalence Analysis.* Generate estimates of the prevalence of SHS exposure as reported by parents in the 2007 National Survey of Children's Health, for comparison with reported results from other national surveys.
2) *Descriptive Analysis.* Describe the population characteristics of children who live with smokers and compare with the overall U.S. child population; examine the prevalence of smokefree homes among children living with smokers overall and by categories within an indicator of the strength of smokefree air legislation in the child's state of residence; and investigate these results within subgroups for children's age, race and ethnicity, primary household language, household income level, family type, parents' education level, and statewide prevalence of smoking among adults.
3) *Regression Analysis.* Develop a multivariate logistic regression model to examine the relationship of strong smokefree air laws with the probability of SHS exposure among children living with smokers, controlling for child-level characteristics (age, race and ethnicity, household income, family type, parents' education) and statewide prevalence of smoking among adults.

The results of this study will contribute to the body of knowledge about the impact of public policy legislation on health behaviors within children's homes and families.

METHODS

2007 National Survey of Children's Health

The National Survey of Children's Health (NSCH) is funded by the Maternal and Child Health Bureau (MCHB) of the U.S. Department of Health and Human Services (DHHS) and administered by the National Center for Health Statistics (NCHS) of the Centers for Disease Control and Prevention (CDC). The survey is designed to provide estimates of national and state-level prevalence for a variety of child health indicators and to inform policymakers, advocates, and researchers concerned with children and their family, health care, and neighborhood environments (van Dyck, et al., 2004). This information is collected in 20-30 minute telephone interviews with parents or other caregivers of a representative sample of children under 18 years of age from each state and the District of Columbia. The NSCH was first conducted in 2003 and is repeated approximately every four years. Public use data files for the second round, the 2007 NSCH, were released in May of 2009. Detailed documentation of design and operation of the 2007 NSCH has been published by the National Center for Health Statistics; the full report is available online (Blumberg, Foster, Frasier, et al., 2012).

Sample selection

The NSCH is designed to represent the population of non-institutionalized children less than 18 years of age in each of the 50 U.S. States and the District of Columbia. This is accomplished by first identifying households with children under 18 and then randomly selecting one child to be surveyed. A target of approximately 1,750 completed

interviews within each state and the District of Columbia was set in order to meet the goal of providing reasonably precise state-level results.

The main sampling frame for the NSCH is provided by the State and Local Area Integrated Telephone Survey (SLAITS) mechanism, which screens households for the National Immunization Survey (NIS). The NIS target population is children 19-35 months old. Identifying a sample of sufficient size for such a small population requires a large number of screening calls. SLAITS takes advantage of this by using the telephone numbers generated for NIS screening as the basis for the NSCH sample.

Strata

In 2007 the NIS strata consisted of a base of 56 non-overlapping geographic areas: six urban areas (Chicago, IL; Philadelphia, PA; New York City, NY; Bexar County, TX; Houston County, TX; and Washington, DC) and 50 state or "rest of state" areas; and eight city or county areas whose immunization programs opted to spend grant funds for oversampling. (NORC, 2008) The areas that were oversampled are: Los Angeles County, CA; Alameda County, CA; San Bernardino County, CA; Miami-Dade County, FL; Marion County, IN; Dallas County, TX; El Paso County, TX, and Western Washington, WA. The 64 estimation areas, or strata, are constructed so that every location in the U.S. is in one and only one estimation area and each is within the borders of a single state.

The targeted number of 1,750 interviews in each state is allocated according to the proportion of the state's households with children residing in each estimation area within that state. The number of telephone numbers to be called was then determined based on

the expected proportion of households with children and the expected proportion of working residential phone numbers, adjusted to account for expected non-response.

A continuous list-assisted random digit dialed (RDD) method is used within each stratum to select telephone numbers for screening. "Banks" of 100 consecutive telephone numbers containing at least one known residential landline are selected at random. In 2007 cellular telephone banks were excluded from the NIS sampling frame because it was known that most households with children also had landline service (Blumberg, Luke, & Cynamon, 2006). Sampling for the NSCH is conducted in three steps in order to minimize overlap with the NIS and NIS-Teen surveys.

All of the phone numbers in the selected banks are called and screened to determine (1) residential status, (2) presence of children in age groups eligible for NIS or NIS-Teen, and finally (3) presence of children under 18. Respondents in the second group are administered the NIS first, followed by the NSCH. Those in the third group completed only the NSCH.

In nine states, the 2007 NIS sample fell short of the number needed for the NSCH: Connecticut, Delaware, Idaho, Kansas, Mississippi, Montana, North Dakota, Oklahoma, and Utah. To achieve the required sample size in these states, the NIS sample was augmented with sampling from outside the NIS sample frame, ranging from 2.6 percent to 18.8 percent of all survey interviews in the nine states.

Questionnaire development

The questionnaire used in the National Survey of Children's Health was developed in 2001 and 2002 by a 28-member National Expert Panel comprised of representatives from State and Federal maternal and child health programs, family organizations, child health

services research, and survey design. The Panel established eight content domains for the survey: demographics, physical and mental health status, health insurance, health care utilization and access to health care, medical home, family functioning, parents' health, and neighborhood characteristics. Two additional sections address developmental issues specific to early childhood (ages 0 – 5) and school age children (ages 6 – 17).

Several panel members were selected to serve on a committee charged with development and testing of questionnaire items for each of the content domains. To maximize comparability of NSCH results with other survey findings and reduce the need for pretesting, items from existing surveys were used whenever possible (Table 1).

TABLE 1. National Survey of Children's Health questionnaire development: Partial list of survey instruments reviewed

Survey	***Sponsor/developer***
National Survey of Children with Special Health Care Needs (NS-CSHCN)	National Center for Health Statistics, for Maternal and Child Health Bureau
National Health Interview Survey (NHIS)	National Center for Health Statistics
Consumer Assessment of Health Plans (CAHPS)	Agency for Healthcare Research and Quality
National Survey of America's Families (NSAF)	Urban Institute, for Annie E. Casey Foundation & others
Promoting Healthy Development Survey (PHDS)	Child and Adolescent Health Measurement Initiative
Living with Illness Survey (LWI)	Child and Adolescent Health Measurement Initiative
Youth Risk Behavior Survey (YRBS)	Centers for Disease Control and Prevention

Review of proposed questions by outside experts and potential data users was integral to the process of selecting items and assembling a questionnaire to be submitted to

MCHB for approval. The questionnaire approved by MCHB was field tested in 2002 for final adjustments before the 2003 survey.

Prior to implementation of the 2007 NSCH, the questionnaire was reviewed extensively and recommended revisions were proposed by the Advisory Committee for the Child and Adolescent Health Measurement Initiative (CAHMI) Data Resource Center on Child and Adolescent Health, and by data users responding to a request distributed to members of the SLAITS listserv, CDC researchers and researchers at Child Trends. A technical expert panel reviewed the suggested revisions, assembled questions for proposed new topics, and made recommendations to MCHB. After pretesting of new and significantly altered questions, the questionnaire was finalized and approved. Content areas and subtopics for the final version of the 2007 NSCH questionnaire are listed in Table 2.

The 2007 NSCH questionnaire was administered using a Computer Assisted Telephone Interview (CATI) system. CATI software is designed to minimize errors by using information already entered to select and display appropriate questions and prompts as it guides interviewers through the questionnaire. Real time on-screen help texts and programmed-in checks for response errors and internal inconsistencies serve to expedite interviews, reduce missing responses, and minimize data cleaning. The NSCH questionnaire was merged with the NIS CATI in order to take advantage of CATI features by accessing information from both surveys to check for legitimate responses and ranges, skip patterns, etc. The integrated CATI is also able to use information provided in the NIS interview to populate responses to the same questions in the NSCH, so that these questions need not to be repeated during the second interview.

TABLE 2. Survey sections and subtopics, 2007 National Survey of Children's Health

NIS Eligibility - Selection of child (S.C.)in household and Informed Consent of adult respondent		
Section & Title	**Subtopics**	
1) Initial Demographics	- Age & sex of sampled child - Number of adults in household - Educational level of parents	- Relationship of respondent to child - Number of children in household - Primary language spoken in household
2) Child Health & Functional Status	- General health status - Special health care needs - Immunizations	- Prevalence & severity of conditions - Participation and activity limitations due to ongoing health conditions
3) Health Insurance	- Current insurance status - Continuity of coverage	- Type of insurance - Adequacy of health benefits
4) Health Care Access & Utilization	- Usual place for care - Utilization of services	- Preventive health and dental care - Unmet needs for health services
5) Medical Home	- Personal doctor or nurse - Family-centered care - Effective care coordination	- Referrals - Provider communication with other health providers and other disciplines
6) Early Childhood (0-5 years)	- Developmental screening - Breastfeeding - Child care	- Injuries - Reading, storytelling, singing, television, playing, & outings
7) Middle Childhood & Adolescence (6-17 years)	- School enrollment - Sleep & exercise - Reading & computing - Television & video	- School engagement - After-school activities & parent involvement - Social behavior & emotional difficulties
8) Family Functioning	- Family activities - Family stress	- Parent/child relationship
9) Parental Health	- Physical health - Mental/emotional health - Physical exercise	- Household composition & nonresident parents - Smokers & smoking in household
10) Neighborhood Environment	- Neighborhood amenities - Neighborhood problems	- Neighborhood social capital - Neighborhood and school safety
11) Additional Demographics	- Race & ethnicity of child - Education of parents - Employment & income - Program participation	- Birthplace of child & parents - Residential mobility - Telephone line information & Zip code (restricted)

The CATI instrument was thoroughly tested to ensure proper functioning. In field testing conducted in December, 2006, the average time required for administration

exceeded the target of 25 minutes, prompting additional changes to the questionnaire before finalization.

Data collection

Data collection for the 2007 NSCH was contracted to the National Opinion Research Center (NORC) at the University of Chicago. All interviews for the 2007 NSCH were conducted by NORC and its subcontractor. A total of 902 interviewers were trained and certified beginning in March, 2007. Training sessions include an introduction and overview, and information about goals, purpose, history, sponsors, and design of the NSCH. Trainees learn about content areas in the questionnaire, principles of quality data collection, how to gain cooperation and respond to frequently asked questions. Targeted exercises and mock interviews are used to reinforce classroom study. After training interviewers whose performance in a mock interview and written test met project standards were certified for the project.

During data collection, call center supervisors are available at all times to provide support and supervision for interviewers. The CATI system assesses interviewer calls for quality and selects calls for monitoring based on experience and performance of the interviewer. Supervisors utilize remote telephone and computer-monitoring technology to evaluate whether interviewers are performing according to project specifications.

Interviewing for the 2007 NSCH was conducted between in April 5, 2007 and July 27, 2008. During this time 91,642 respondents were interviewed. The final dataset includes 90,557 completed interviews and 1,015 partial interviews. The latter were retained if the interview ended after the first six sections were completed (through Section 6 or 7, depending on the age of the selected child). By the end of 2007, 79

percent of the interviews had been completed, and by April 30, 2008, 98 percent were done (Table 3).

TABLE 3. Number of interviews completed by month, 2007 National Survey of Children's Health

Month	Total[1]	Percent	Cumulative Percent
April 2007	4,435	4.8	4.8
May 2007	9,074	9.9	14.7
June 2007	9,449	10.3	25.0
July 2007	10,538	11.5	36.5
August 2007	11,208	12.2	48.7
September 2007	8,679	9.5	58.2
October 2007	7,454	8.1	66.3
November 2007	6,137	6.7	73.0
December 2007	5,269	5.8	78.8
January 2008	5,472	6.0	84.8
February 2008	4,542	5.0	89.8
March 2008	5,331	5.8	95.6
April 2008	2,533	2.8	98.4
May 2008	849	0.9	99.3
June 2008	460	0.5	99.8
July 2008	212	0.2	100.0
All months	91,642	100.0	

[1]Total number of interviews includes partially completed interviews.

An advance letter is mailed to all households sampled for which a mailing address could be identified, about 10 days prior to attempting phone contact. Six versions of the letter were used, depending on the circumstances under which the NSCH was to be administered, e.g., combined NIS and NSCH interview, NIS and NSCH interviews at different times, NSCH only selected in SLAITS, or from the NSCH only augmentation sample. All versions of the letters include information about the subject, methods and purpose of the survey, as well as toll-free telephone numbers to call to ask questions, verify that the survey is legitimate, or schedule a convenient appointment time to do the

survey. Advance letters were mailed for 59 percent of the telephone numbers later dialed by interviewers for the 2007 NSCH. Receipt of a letter is not required for participation in the survey. The information and toll-free numbers in the letters are also provided to each household contacted by telephone, whether or not a letter was mailed to that household.

Calls were made from two centers, one located in Chicago, the other in Las Vegas. Every telephone number selected is dialed at least six times at different times on different days, or until contact was made.

When a residential household is reached, the interviewer asks a serious of questions to establish the presence of at least one adult over 18 and whether the household includes children less than 18 years of age. If both are true, the age of each child is obtained and one child is randomly selected to be the subject of the interview. In households with only one child, that child is automatically selected. At that point the interviewer asks to speak with parent or other adult in the household who is familiar with the selected child's health and health care. In 74 percent (unweighted) of the interviews included in the final dataset for the 2007 NSCH, the adult respondent was the mother of the selected child and 20 percent were fathers. The remaining six percent were grandparents (4.2 %), other relatives (1.3%), and guardians (0.5%).

Prior to asking any interview questions, the interviewer informs the respondent of his or her rights as a participant and verbal consent from the respondent is recorded in the CATI before proceeding. Respondents are assured that the information they provide during their interview will be kept in the strictest confidence, and if applicable, terms of cash incentives are explained. The NCHS Research Ethics Review Board and the NORC Institutional Review Board approved all study procedures and modifications.

Although initial contacts are made by English-speaking interviewers, respondents whose primary language is Spanish are referred to bilingual interviewers for administration of the Spanish language version of the CATI. Interviews are also available for speakers of four Asian languages: Mandarin, Cantonese, Vietnamese, or Korean. Households needing other languages are screened in their native language to determine eligibility, but are not asked to complete the survey. In the 2007 NSCH 688 households with age-eligible children were resolved as having incomplete interviews due to language.

The NCHS uses several strategies to maximize response rates for the 2007 NSCH. In addition to advance letters and toll-free information numbers, flexible calling schedules, cash incentives, translated questionnaires, and refusal conversion efforts, information gathered during pretesting was used to adjust the questionnaire and survey procedures to minimize the impact of sensitive questions on responses. A coordinated sample management plan removed duplicates, known businesses, and numbers on the NIS "Do not call list" from sample replicates. Care is taken to limit the number of surveys each household is asked to participate in. In 2007, 47 percent of the telephone numbers in the sample were resolved by other means prior to dialing. Call schedules are coordinated to avoid confusion between NSCH and NIS calls to respondents.

Response rate

Calculation of response rates is based on resolution rate, age-screener completion rate, and interview completion rate. The resolution rate is the proportion of sampled telephone numbers that were identified as either residential or non-residential. Most of

the unresolved phone numbers were not answered after a minimum of six calls on different days and at different times.

The age-screener completion rate is the proportion of telephone numbers identified as belonging to residences, in which it was determined whether or not children under 18 years of age reside in the household. The interview completion rate is the proportion of households with age-eligible children that completed Section 6 or 7 of the questionnaire.

The overall completion rate is the product of the resolution, age-screener, and interview completion rates. Table 4 shows weighted response rates for the 2007 NSCH using two different methods of calculating the resolution rate. Standard estimates assume that the proportion of residential households is the same for unresolved cases as for those that were ascertained. Estimates in the "Alternative" column rely on the less conservative but more probable assumption that numbers resulting in no contact were non-residential.

TABLE 4. Response rates: 2007 National Survey of Children's Health

	***Standard*[1]**		***Alternative*[2]**	
	Nationwide	State Range	Nationwide	State Range
Resolution rate	81.9%	77.2%-89.2%	89.9%	86.4%-94.1%
Age-screener completion rate	86.4%	83.4%-90.6%	86.4%	83.4%-90.6%
Interview completion rate	66.0%	59.0%-76.6%	66.0%	59.0%-76.6%
Overall response rate[3]	46.7%	39.4%-61.9%	51.2%	44.9%-64.9%

[1]The standard resolution rate and overall response rate assume that the proportion of residential households among unresolved telephone lines is the same as observed among the telephone numbers that were resolved (CASRO).

[2] The alternative resolution rate and overall response rate assume that all telephone numbers for which all call outcomes were "ring, no answer" or busy signals are not households.

[3]The overall response rate is the product of the resolution rate, the age-screener completion rate, and the interview completion rate.

Post-interview adjustments for sampling bias

Each record in the dataset is weighted according to several factors. A base sampling weight is assigned, which is the inverse of the probability of a single phone line being selected in its geographic area. The base sampling weight is further adjusted for:

- Number of phone lines in the child's home,
- Non-response bias from unknown household status or eligibility, and
- Number of children in the household.

Post-stratification adjustments are made to match the weighted results to the demographic composition (age, sex and race) of the non-institutionalized under-18 population of each state. The weights are also adjusted to account for the proportion of households in the state that did not have phone coverage at the time of the survey. And finally, very large weights are truncated to avoid excessive influence of small numbers of cases on the results.

The final sample of 91,642 records is weighted up to represent the estimated number of children in each state and the District of Columbia in 2007, totaling 73,758,616. Weights range from a minimum of 0.50 up to a maximum of 34,724.4 for individual respondents. Nationally, the median weight is 324.7, while the mean is 804.9. Respondents in the most populous states, California (5,363.8), Texas (3,645.2), New York (2465.7), and Florida (2235.9), have the highest mean weights. A detailed description of weighting methods used for the 2007 NSCH is reported in the methodology report for the survey (Blumberg, Foster, Frasier, et al., 2012).

Edits to protect the confidentiality of respondents

After all of the interviews were completed, a SAS (version 9.1) data file was constructed by transferring CATI data from the 91,642 completed and partially completed interviews. These records were screened for logical errors and invalid values were deleted. Missing values investigated and coded according to the reason they are missing.

To prepare the NSCH dataset for public release, the National Center for Health Statistics takes great pains to prevent inadvertent or deliberate identification of individual respondents. Zip code, income, immigrant status, non-English language, race and ethnicity, and other variables are aggregated, adjusted, or restricted. Continuous variables such as height, weight, number of doctor and hospital visits, missed school days, hours of screen time, etc., are top-coded or bottom coded. To further protect confidentiality perturbations are introduced into the data to ensure individuals with unusual combinations of characteristics are not identifiable.

In 8.5 percent of the interviews, respondents were not able or willing to provide sufficient information to calculate the child's household income as a percentage of the Federal Poverty Level. The NSCH developed a set of multiple imputation files in SAS, according to an algorithm designed to match characteristics of respondents whose income is not known with other similar respondents with known incomes.

De-identified SAS datasets and multiple imputation income data files for the 2007 NSCH are posted on the CDC website and may be downloaded free of charge. The CAHMI Data Resource for Child and Adolescent Health provides at no charge, cleaned and labeled enhanced versions of the datasets in SPSS and SAS.

Human subjects protection

All study procedures and modifications for the 2007 NSCH were approved by the NCHS Ethics Review Board and the NORC Institutional Review Board, as specified in DHHS regulations (45 CFR 46). The Federal Office of Management and Budget control number for this collection of information was 0920-0406. The Oregon Health & Science University (OHSU) Institutional Review Board (IRB) granted approval of this study on March 16, 2009.

Data management

The 2007 NSCH data file was obtained in May of 2009 from the Data Resource Center for Child and Adolescent Health (DRC), a project of the Child and Adolescent Health Measurement Initiative (CAHMI) based at OHSU. SPSS Base and Complex Samples software versions 19.0 and 20.0 were used for data storage and management. The code used for variable construction and statistical analysis is written and stored in SPSS syntax files.

All records in the dataset were retained as required for correct variance estimation in complex samples analysis. Rather than eliminating records not used in regression analysis, a subpopulation variable was used to identify study sample records for analysis. In this way, exactly the same set of records was used throughout each analysis. A complex samples plan was constructed in SPSS Complex Samples, with the record identifier variable IDNUMR as the primary sampling unit, STATE as the strata, NSCHWT as the weight, and specifying sampling with replacement.

State-level variables were constructed and tested in a separate dataset, then merged with NSCH records based on state of residence, so that each record in the NSCH dataset

included additional fields for adult smoking prevalence and state smokefree air legislation for the state in which the selected child lives.

Inclusion criteria

The 2007 NSCH dataset includes records for children who at the time of the interview were younger than 18 years, living in a residence in the United States with at least one adult parent or caregiver whose primary language is English, Spanish, or one of four most prevalent Asian languages in the U.S. (Table 5). The selected child's parent or caregiver must also have completed at least the first five sections of the questionnaire and either Section 6 (children under 6 years of age) or Section 7 (children 11-18 years of age). Since sampling and data collection were conducted by telephone, children must live in residences with working landline (not cellular) voice telephone service in order to be selected. These criteria were met for 91,642 children whose records are included in the 2007 NSCH dataset.

Each outcome in the prevalence analysis (Aim 1) has a separate analytic group. Prevalence estimates for the outcome "Smoker in household" include the 90,970 children for whom a valid response is recorded to the item that asks whether anyone in the child's household uses cigarettes, cigars, or pipe tobacco. Those with responses of "Don't know" or "Refused" (n= 44) or for whom no response is recorded for this question (n=628) are excluded from these estimates.

The group for which overall prevalence of in-home exposure to SHS is presented is the same as the first group, except that nine records are excluded because of invalid (n=8) or missing (n=1) responses to the second question. The denominator for this outcome is 90,961 children.

The conditional prevalence group is confined to 22,374 children whose parents report that someone in the household smokes tobacco. Those not living with smokers (n=68,587) are excluded, as well as children whose status is unknown (n=52) or missing (n=629) for either item.

TABLE 5. Inclusion and exclusion criteria

	Included	*Excluded*
2007 NSCH (n=91,642)	Child age 17 or younger	18 or older
	Child lives in a household with at least one parent or caregiver (non-institutionalized)	Institutionalized or emancipated
	Child resides in any U.S. State or District of Columbia	Not a U.S. resident
	Child's household has at least one working voice-use telephone line	No voice telephone service or not reached by telephone
	Child's parent or guardian is able to communicate in English, Spanish, Korean, Vietnamese, Chinese, or other language	Parent or caregiver language other than the six listed
	Child's parent or caregiver consented to and completed CATI through Section 6 if under six, or Section 7 if 6-17 years old.	Parent or caregiver refused or broke off interview before completing Section 6 or 7
	Included	*Excluded*
SHS Study	Met NSCH inclusion criteria and interview record appears in public use data file for 2007 NSCH	No record in 2007 NSCH public use data file
Aim 1 All children	Response of "Yes" or "No" to K9Q40, "Does anyone living in your household use cigarettes, cigars, or pipe tobacco?"	Response to K9Q40 is "Don't know" or "Refused" or no response was recorded
Aim 1 Living with smoker	If Response of "Yes" to K9Q40, Response of "Yes" or "No" to K9Q41, "Does anyone smoke inside the child's home?"	Response to K9Q41 is "Don't know" or "Refused" or no response was recorded
Aim 2 & 3 Living with smoker	Record includes a valid response for all variables in the analysis	Invalid or missing response for race-ethnicity, household language, education level, or family type

The focus of the logistic regression analysis (Aims 2 and 3) is children who live in households with smokers. The sample for this analysis is comprised of children whose households include smokers who also have valid responses for whether or not smoking occurs inside their home and four key demographic characteristics: race and ethnicity, household language, education level, and family type. Records lacking one or more responses total 262, less than 1.2 percent of the 22,374 cases (weighted and unweighted) with valid outcome data. Based on the small number, we chose to drop these from the analysis rather than imputing values for them. The remaining 22,112 records meet criteria for inclusion in the logistic regression analysis.

Study sample variables for Complex Samples analysis

Because of the stratified sampling methods it was necessary to construct dichotomous variables to distinguish records to be included from those not included in analytical procedures. For the prevalence analysis we created a variable for each of three outcomes:

1) Smoker in household: "In Sample" if response to K9Q40 is "Yes" or "No"; "Not in Sample" if response to K9Q40 is missing or invalid

2) Smoking in home (all children): "In Sample" if response to K9Q40 is "No" or if K9Q40 is "Yes" and K9Q41 is "Yes" or "No"; "Not in Sample" if response to K9Q40 is missing or invalid or, if K9Q40 is "Yes" and K9Q41 is missing or invalid.

3) Smoking in home (smoker in household): "In Sample" if response to K9Q41 is "Yes" or "No"; "Not in Sample" if response to K9Q41 is missing or invalid.

For the regression analysis, the third variable above was modified by moving out of the sample population 262 records with missing or invalid responses to any of the demographic variables.

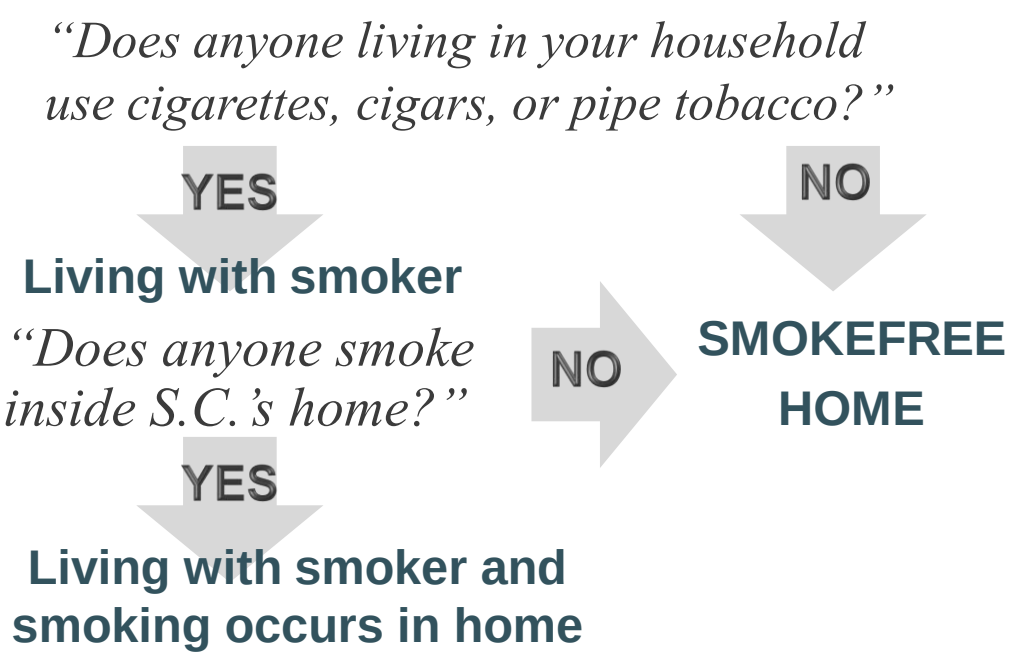
Dependent variables

Figure 1, below, illustrates the questions and responses used to construct outcome variables used for the prevalence and logistic regression analyses (Aim 1 & 2).

For population prevalence estimates, two outcome variables were constructed using survey items pertaining to smoking in children's homes. "Smoker in household" is defined as a response of "Yes" to the question, "Does anyone living in your household use cigarettes, cigars, or pipe tobacco?"

The second outcome "Smoking in home" requires a response of "Yes" to both questions. This definition is based on the assumption that children living in households in which no residents are smokers are not exposed to secondhand tobacco smoke. Prevalence of "Smoking in home" was examined for the overall child population and for the subpopulation of children living with smokers.

Figure 1. Dependent variables



For the logistic regression analysis, the outcome of interest is "Smokefree home" among children living with tobacco smokers. The dependent variable used is identical to "Smoking in home" except that the reference category is reversed so that the outcome modeled is having a smokefree home (Table 6).

TABLE 6. Dependent variables derived from the 2007 National Survey of Children's Health

Variable	*NSCH Source*	*Question/description*	*Response set*	*Coding for analysis*
Smoker in household	K9Q40	"Does anyone living in your household use cigarettes, cigars, or pipe tobacco?"	No Yes Unknown	0=No smokers living in child's household 1=Smoker in household
Smoking in home	K9Q40	"Does anyone living in your household use cigarettes, cigars, or pipe tobacco?"	No Yes Unknown	0=Smokefree home (smoker in household OR smoker in household but no smoking inside home) 1=Smoking in home (smoker in household AND smoking occurs inside home)
	K9Q41	"Does anyone smoke inside S.C.'s home?" (asked only if response to K9Q40 is "Yes")	No Yes Unknown	
Smokefree home	K9Q40	"Does anyone living in your household use cigarettes, cigars, or pipe tobacco?"	No Yes Unknown	0=Smoking in home (smoker in household AND smoking occurs inside home) 1=Smokefree home (smoker in household OR smoker in household but no smoking inside home)
	K9Q41	"Does anyone smoke inside S.C.'s home?" (asked only if response to K9Q40 is "Yes")	No Yes Unknown	

Demographic variables

Selection of demographic variables for analysis was guided by results of previous studies of SHS exposure and home smoking rules (Mannino, Moorman, Kingsley, Rose, & Repace, 2001; Soliman, Pollack, & Warner, 2004; Mills, White, Pierce, & Messer, 2011; Pirkle, Bernert, Caudill, Sosnoff, & Pechacek, 2006; Hawkins & Berkman, 2011; Schuster, Franke, & Pham, 2002; Gilpin, White, Farkas, & Pierce, 1999; King, et al., 2009; Binns, O'Neil, Benuck, Ariza, & Pediatric Practice Research Group, 2009).

Relevant variables in the 2007 NSCH dataset were examined and recoded to achieve measures appropriate for analysis, using all records in the dataset (Table 7).

NSCH variables for race and Hispanic ethnicity were used to create a single variable with categories for children of Hispanic or Latino ethnicity regardless of race, and non-Hispanic children identified as White, Black (African American), Multi-racial, or Other (Asian, Native American, and others).

A variable for the primary caregiver's highest level of education was derived from separate questions asked for parents or caregiver living in the household. For this variable the mother's education level is selected if a valid response is given. In the absence of a valid response for the mother, the father's level of education is evaluated and selected if a valid response is given. If a valid response is not available either parent, but is recorded for a non-parent caregiver who is the survey respondent, that value is included. Otherwise, the response is designated as unknown.

The study variable for household income level is based on a variable in the NSCH public use dataset that includes estimated income for each of the 7,817 records in which income level could not be ascertained. Availability of these estimates permits inclusion of cases that would otherwise be lost in listwise deletion. The rationale and methods used to derive imputed values for household income level are described in detail elsewhere (Blumberg, Foster, Frasier, et al., 2012). Four response values in the NSCH variable are combined to create a single category for all income levels between 100 and 199 percent of Federal Poverty Level (FPL), so that the study variable response groups step up from FPL to twice, three times, and four times FPL. Since estimated values are included in this variable, none of the records are missing a value for household income level.

TABLE 7. Demographic variables derived from the 2007 National Survey of Children's Health

Variable	*NSCH Source*	*Question/ description*	*Response set*	*Coding for analysis*
Age of child.	AGEYR_CHILD	Age in years	Age (0 -17)	1=0-5yrs 2=6-11 yrs 3=12-17 yrs
Race and ethnicity of child	HISPANIC RACER	Composite of Hispanic ethnicity and racial group	Hispanic: No; Yes, Don't know/ Refused Race: White, Black, Multi-racial, Other, Don't know/ Refused	1=Hispanic, any race 2=White non-Hispanic 3=Black non-Hispanic 4=Multi non-Hispanic 5=Other non-Hispanic 99=Unknown
Primary house-hold language	PLANGUAGE	Main language spoken in the child's household	English Any other language	1=English 2=Other 99=Unknown
House-hold income level	POVLEVEL_I	Household income as percentage of Federal Poverty Level (FPL); Missing values estimated by single imputation using NCHS data file; 5 categories	Less than FPL 100-133% FPL 133-149% FPL 150-184% FPL 185-199% FPL 200-299% FPL 300-399% FPL 400% or more	1=Below FPL 2=100-199% FPL 3=200-299% FPL 4=300-399% FPL 5=400% or more
Education level of parent	EDUC_MOMR EDUC_DADR EDUC_RESR	Derived, highest level of education attained by mother, father, or other respondent living in child's household	Less than high school, High school or GED, College/other post-HS, Don't know/Refused, Missing/Skip	1=Less than high school 2=High school/GED 3=College/other post-HS 99=Unknown
Family structure	FAMSTRUCT	Derived by NCHS from questions about household members	2 parents, bio/adoptive, 2 parents, step/blended, 1 mother, no father, All other types, Don't know/Refused	1=2-parent bio/adoptive 2=2-parent step/blended 3=Single mother, no father in household 4=Other family types 99=Unknown

Child's age was collapsed into three groups: early childhood (under 6 years), middle childhood (6-11 years) and adolescence (12-17 years). Since the child's age is required for age-eligibility screening, every case in the NSCH dataset has a valid value for the child's age. NSCH categories for Family Structure were not modified.

Missing responses and responses of "Don't know" or "Refused" were recoded into a single "Unknown" category in four variables: Race-ethnicity, Primary household language, Family type, and Education level.

State-level variables

Two state-level variables were merged with the 2007 NSCH microdata: adult smoking prevalence and a rating of Smokefree Air legislation (Table 8).

TABLE 8. State-level variables

Variable	*Source*	*Question/description*	*Response set*	*Coding for analysis*
Statewide adult smoking prevalence	2006/07 TUS-CPS	Persons ≥ 18 years old who have ever smoked ≥ 100 lifetime cigarettes AND currently smoke either daily or on some days	50 states and D.C. grouped by quintiles of increasing adult smoking prevalence	1=Lowest (12.4-16.4%) 2=Mid-low (16.5-18.5%) 3=Middle (18.6-20.6%) 4=Mid-high (20.7-22.5%) 5=Highest (22.9-28.2%)
Strength of smokefree air laws in child's state of residence	"State of Tobacco Control: 2006" American Lung Assn	Rating of state and local "Smokefree Air" laws in effect by January 1, 2007. Scores based on legislation banning smoking in 8 venues, penalties, enforcement, and pre-emption.	"Perfect" score of 36 points and up to 6 bonus points for extra provisions. States graded as: A = 33 - 40 points B = 29 - 32 points C = 26 - 28 points D = 22 - 25 points F = 0 - 21 points	1=Strong (36-40 points) 2=Adequate (29-35 points) 3=Inadequate (0-21 points)

To account for possible confounding by social norms regarding adult smoking, statewide prevalence of smoking among adults 18 years of age or older is included as a categorical variable, aggregated into quintiles according to ascending prevalence. Estimates were obtained from published results from the 2006/07 Tobacco Use Supplement to the Current Population Survey (TUS-CPS) conducted by the U.S. Census Bureau (Giovino, Chaloupka, Hartman, et al., 2009, p. 26). This measure defines "adult" as an individual 18 years of age or older and current smoking is defined as (1) ever

smoked 100 or more cigarettes and (2) currently smokes on some or all days (Giovino, Chaloupka, Hartman, et al., 2009, p. 24).

For an indicator of the quality of each state's smokefree indoor air legislation at the time of the survey, we considered measures reported in recent studies. Two types of measure are prominent in current literature. The first is based on the percent of population covered by 100% smokefree laws in one or more of three venues: private workplaces, restaurants, and bars. In recent studies, these indicators were consistently used with sub-state geographic units such as counties or municipalities (Cheng, Glantz, & Lightwood, 2011; Dove, Dockery, & Connolly, 2010; Pickett, Schober, Brody, Curtin, & Giovino, 2006). Information about state legislation was available, but used only in conjunction with sub-state data. The American Non-Smokers' Rights Foundation (ANRF) maintains a database with detailed information on national, state, and local anti-smoking legislation, which provides the source data for these measures (ANRF).

The second measure considers statewide legislation for eight public and private venues. In addition to the "gold standard" venues (private workplaces, restaurants, and taverns or bars), this system also rates the quality of state smokefree indoor air legislation addressing government workplaces, schools, child care facilities, retail stores, and recreational or cultural facilities. The rating system includes assessment of the strength of penalties, provisions for enforcement, and considers the impact of pre-emptive state legislation. Initial development of the system is described in Chirqui et al, (2002). Data for these measures are available from the State Legislated Actions on Tobacco Issues (SLATI) online database provided by the American Lung Association (ALA). For the past two decades the American Lung Association has published an annual report "State

of Tobacco Control" with state report cards on Smokefree Air and three other areas of tobacco control legislation and policy (American Lung Association, 2006).

We chose to use the second type of indicator for this study for two reasons. The first is that SLATI data, although state-level, includes information on many public and private venues, including some more that may be more likely to be frequented by children and families, e.g., schools and day care, retail outlets, and recreational or cultural facilities. Also, the SLATI tracks state legislative mandates that can strengthen or weaken the effectiveness of smokefree air legislation: penalties, enforcement, and pre-emption. The second reason is that sub-state identifiers are not provided in the public dataset for the NSCH. As a result, the population focus and sub-state capability of the ANRF measures is not helpful for this study.

The measure of the strength of state smokefree indoor air legislation is derived from data in the ALA report, "State of Tobacco Control: 2006" (American Lung Association, 2006), which uses information from the SLATI database to assign each state points for specified legislative provisions restricting smoking in eight public and work venues, and setting forth penalties, enforcement, and pre-emptive rules. The scope is statewide legislation implemented by January 1, 2007, three months before data collection began for the 2007 NSCH. For analytical purposes, state scores are consolidated into three categories:

1. "Strong" scores of 36 or above (11 states)
2. "Adequate" or better scores of 29-35 (17 states)
3. "Inadequate" scores of 21[1] or less (23 states)

[1] In 2006 none of the states received scores between 22 and 28 points.

Components of the 2006 SOTC state smokefree indoor air scores are: shown in Table 9 below. To achieve a Strong score, state legislation must meet or exceed target criteria for all categories. Adequate states had less than perfect scores in one or more categories, but their total score was more than 80 percent of the 36 target points. The remaining 23 states qualified for less than 60 percent of the target points and are characterized as Inadequate with respect to smokefree indoor air legislation.

TABLE 9. Scoring criteria, 2006 State of Tobacco Control grading system

	Target provisions			*Bonus provisions*	
Category	**Pts**	**Target criteria**	**Deductions***	**Pts**	**Bonus criteria**
Government workplaces	4	100 percent smokefree, no exemptions	Restriction depends on type of ventilation and/or location of smoking area	1	Meets target criteria AND requires grounds or a specified distance from entries or exits to be smokefree
Private workplaces	4	100 percent smokefree, no exemptions	Restriction depends on type of ventilation and/or location of smoking area	1	Meets target criteria AND requires grounds or a specified distance from entries/exits be smokefree
Schools	4	No smoking permitted during school hours or while school activities are being conducted	Restriction depends on school hours, type of ventilation, and/or location of smoking area	1	Meets target criteria AND extends smoking ban to any time in school facilities including buildings, grounds, etc.
Childcare facilities	4	No smoking permitted during operating hours in childcare facilities, including licensed and home-based facilities	Restrictions depend on ventilation standards or location of smoking areas or provide exemptions for certain types of facilities	0	None
Restaurants and bars	4	Restaurants, including bar areas of restaurants, are 100 percent smokefree	Restriction depends on type of ventilation and/or location of smoking areas, and has exemptions for some restaurants	1	Meets target criteria AND extends ban to bars and taverns, including outdoor seating
Retail stores	4	Retail stores or retail businesses open to the public are 100 percent smokefree	Restriction depends on ventilation standards and/or location of smoking area, and if laws apply to some but not all retail stores or businesses open to the public	0	None

TABLE 9. Scoring criteria, 2006 State of Tobacco Control grading system

		Target provisions			*Bonus provisions*
Category	**Pts**	**Target criteria**	**Deductions***	**Pts**	**Bonus criteria**
Recreational or Cultural facilities	4	100 percent smokefree	Restriction depends on ventilation standards and/or location of smoking area, and if laws only apply to some but not all recreational and/or cultural facilities	0	None
Penalties	4	Penalties or fines applicable to smokers and to proprietors or employers, for any violation of clean indoor air legislation	Penalties include possible delay, exceptions for smokers or proprietors / employers, or penalties do not apply to all offenses, intent requirement or affirmative defense	1	Laws meet target criteria and penalties or fines are graduated for repeated violations
Enforcement	4	Designates enforcement authority and requires signage	No requirement for sign posting, enforcement authority only applies to some sites, or enforcement authority or sign requirement exists, but not both	1	Laws meet the target criteria and require the enforcement authority to conduct compliance inspections
Total	36	State legislation meets target		6	State legislation exceeds target

* For all categories, laws that require that smoking be permitted or laws without any restrictions for the particular category receive a score of zero.

Source: State of Tobacco Control: 2006. American Lung Association.

Statistical Analysis

Prevalence analysis – All children and children living with smokers

The objective of the prevalence analysis is to permit comparison between the prevalence of SHS outcomes as reported by parents in the 2007 National Survey of Children's Health with results reported from other national surveys.

Overall prevalence

Frequency distributions were computed to determine the prevalence of each of the two dependent variables. Conditional prevalence was calculated for the second outcome,

"Smoking in home," using a subpopulation command. Unweighted and weighted counts, point estimates, standard errors, and 2-tailed 95 percent confidence intervals (95% CI) were computed.

Prevalence within child subgroups

Prevalence estimates for outcomes were obtained by 2-way cross-tabulation of each dependent variable with the demographic and state-level covariates. Results were generated for the overall child population and, for the second outcome, for the population of children living with smokers. Unweighted and weighted counts, point estimates, standard errors, and 2-tailed 95% CIs were computed.

Descriptive analysis – Children living with smokers

Descriptive and prevalence statistics are generated in order to examine differences and similarities between characteristics of the study population, children living with smokers, and the overall child population, and between outcome prevalence in various subgroups within the study population.

Distribution within child subgroups

Frequency distributions were calculated for all demographic and state-level subgroups among all children and within the subpopulation of children living with smokers. Output included unweighted and weighted counts, weighted point estimates, and standard error and 2-tailed 95 % CIs for weighted estimates. Records with responses categorized as "Unknown" were included in this analysis.

Prevalence within child subgroups by state smokefree indoor air indicator

Cross-tabulation of dependent variable "Smokefree home" with each demographic variable and the state-level variable for adult smoking prevalence were performed for all

children living with smokers and within each of the smokefree indoor air categories. Weighted row percentages, standard errors, and 95 percent confidence intervals were computed.

Logistic regression analysis– Children living with smokers

Logistic regression analysis is used in this study is to examine the association of Strong smokefree air laws with the probability of children who live with smokers having a smokefree home depending on selected demographic characteristics, and according to the strength of state-level smokefree indoor air legislation.

Univariable logistic regression analysis

Weighted simple logistic regression models were constructed for each covariate, modeling the odds of living in a smokefree home for children living with smokers. Pseudo -2 log likelihood, Pseudo R-Square, and adjusted Wald F statistics and associated p-values were used to assess univariate relationships. The criterion for inclusion in the multivariable model was set at $p<0.05$ for the Wald F statistic.

Multivariable logistic regression analysis

Independent variables that met the criterion for significance in univariate analysis were entered into a multivariable model individually. Covariates were retained in the preliminary main effects model if any of their beta-coefficients were statistically significant ($p<0.05$). As variables were introduced into the multivariable model, the behavior of other variables in the model was observed to identify possible interactions.

Once the main effects model was established, interaction terms were assessed for race/ethnicity, household income level, statewide adult smoking prevalence, and strength of smokefree indoor air legislation with each of the other covariates in the main effects

model. Each interaction was introduced individually and assessed for significance of the Wald F statistic for the variable and beta-coefficients for the parameters. Terms with $p<0.05$ for Wald F or one or more beta coefficients when added individually to the model were reintroduced simultaneously. Those with the highest Wald F p-value and $p>0.05$ for all beta coefficients were removed one by one until $p<0.05$ for all of the remaining interaction variables. These variables were evaluated for cell size and dropped if cell size was insufficient. Finally, the public health value of each interaction term was considered and those that offer meaningful information were retained in the final model.

Model fit was assessed using the Cox and Snell Pseudo R-Square statistics.

RESULTS

Prevalence analysis – All children and children living with smokers

Overall prevalence

According to the 2007 National Survey of Children's Health, just over one quarter of all U.S. children under 18 years of age live in households in which someone uses cigarettes, cigars, or pipe tobacco (Table 9). Of these 19 million children, about 5.5 million are exposed to secondhand smoke inside their homes.

TABLE 10. Prevalence of in-home secondhand smoke exposure, U.S. children age 0-17 years, 2007 National Survey of Children's Health

Smoker in household, all children	Percent	(95% C.I.)	Population	Count
No smokers in child's household	73.8%	(73.1 – 74.5)	54,013,284	68,587
Household includes tobacco smoker	26.2%	(25.5 – 26.9)	19,141,944	22,383
Total	100.0%	--	73,155,228	90,970
Smoking in home, all children	**Percent**	**(95% C.I.)**	**Population**	**Count**
No smokers OR home is smokefree	92.4%	(92.0 - 92.8)	67,607,600	84,530
Smoking occurs inside child's home	7.6%	(7.2 - 8.0)	5,541,329	6,431
Total	100.0%	--	73,148,929	90,961
Smoking in home, living with smoker	**Percent**	**(95% C.I.)**	**Population**	**Count**
Child's home is smokefree	71.0%	(69.7 - 72.4)	13,594,316	15,943
Smoking occurs inside child's home	29.0%	(27.6 - 30.3)	5,541,329	6,431
Total	100.0%	--	19,135,645	22,374

Subpopulations

Smoker in child's household

The proportion of U.S. children living with smokers differs greatly between demographic subpopulations (Table 10). Highest prevalence occurs among children living in step- or blended two-parent families. Likelihood of living with a smoker was

also very high among children from low-income households (below 200% of Federal Poverty Level guidelines), children whose parents have no education or training beyond high school, those in single-mother or "Other" types of families, Multi-racial non-Hispanic children, and children living in the 10 states with highest adult smoking prevalence. Lowest prevalence of households with smokers was observed among children in the highest categories of household income and education, from non-English speaking households, and "Other" non-Hispanic race.

Smoking occurs inside child's home

Assuming that children living in households with no smokers would not ordinarily be exposed to secondhand tobacco smoke on a daily basis, the overall prevalence of substantial in-home SHS exposure is equivalent to the proportion of children living with smokers whose parents indicate that smoking occurs inside the child's home. The second column in Table 10 shows the population prevalence of in-home SHS exposure overall (7.6%) and within key demographic subpopulations.

SHS exposure increases significantly with age, from less than five percent during early childhood, to just over 10 percent among youth ages 12-17. A similar dose-response pattern is evident between income levels, with children from households with below-poverty incomes six times as likely to be exposed as children in the highest income category.

Differences between the three largest race and ethnicity groups are more pronounced for in-home SHS exposure than for prevalence of living with a smoker. Hispanic children, along with non-Hispanic children of other races (including Asian, Native American, but not White or African American), enjoy lowest prevalence rates. Although

their prevalence of living with smokers is no different from the overall prevalence, African American non-Hispanic children are five times as likely as Hispanic children to have smoking occurring inside their homes. On the other hand, among children in step or blended families the prevalence of in-home SHS exposure is similar to that of children with single mothers even though 42 percent of the children in this group live with someone who smokes.

The prevalence of SHS exposure increases with increasing state adult smoking prevalence and with weaker smokefree air legislation.

Smoking occurs inside child's home (children living with smokers, only)

The third column in Table 10 shows the prevalence of SHS exposure (smoking occurs inside child's home) among children living with smokers, overall and within demographic subpopulations. Again, we observe incremental changes by income level, age group, adult smoking prevalence, and state smokefree indoor air rating. Characteristics associated with reduced risk of SHS exposure include non-English household, Hispanic ethnicity, high income, low adult smoking prevalence, and under six years of age. African American children are least likely to be protected from SHS in their homes; 50 percent of those who live with smokers live in homes in which smoking occurs.

Across all three prevalence measures, children living in states with Adequate and Strong Smokefree Air ratings in 2006 fared much better than those in states that scored poorly.

TABLE 11. Prevalence of in-home secondhand smoke exposures within U.S. child population subgroups, 2007 National Survey of Children's Health

	Smoker in household, all children		**Smoking in home, all children**		**Smoking in home, living with smokers**	
	Percent	(95% C.I.)	Percent	(95% C.I.)	Percent	(95% C.I.)
Total overall prevalence	26.2%	(25.5-26.9)	7.6%	(7.2 - 8.0)	29.0%	(27.6-30.3)
Child's Age						
0 - 5 years	25.8%	(24.5-27.1)	4.8%	(4.3-5.4)	18.8%	(16.8-20.9)
6 - 11 years	25.4%	(24.2-26.7)	7.4%	(6.7-8.0)	29.0%	(26.6-31.4)
12 - 17 years	27.2%	(26.1-28.4)	10.4%	(9.7-11.2)	38.3%	(36.0-40.6)
Child's race/ethnicity						
White NH	27.3%	(26.5- 8.1)	8.0%	(7.5-8.5)	29.2%	(27.6-30.9)
Hispanic (any race)	22.6%	(20.5-24.7)	2.6%	(2.2-3.1)	11.6%	(9.6-14.0)
Black NH	27.1%	(25.4-29.0)	13.6%	(12.2-15.1)	50.1%	(46.3-53.9)
Multi-racial NH	35.5%	(31.5-39.9)	10.8%	(8.8-13.2)	30.4%	(24.6-37.0)
Other race NH	17.8%	(15.0-20.9)	3.2%	(2.4-4.3)	18.2%	(13.5-23.9)
Primary household language						
English	27.3%	(26.6-28.1)	8.5%	(8.1-9.0)	31.2%	(29.8-32.6)
Not English	18.6%	(16.3-21.1)	1.3%	(0.9-1.9)	7.1%	(4.9-10.1)
Unknown	13.8%	(3.9-38.7)	2.2%	(0.5-9.0)	16.0%	(2.6-57.9)
Household income (% FPL*)						
Less than 100%	36.9%	(35.0-38.9)	13.7%	(12.5-14.9)	37.1%	(34.2-40.0)
100% - 199%	33.9%	(32.2-35.7)	11.0%	(10.0-12.1)	32.5%	(29.8-35.3)
200% - 299%	28.7%	(26.9-30.5)	8.0%	(7.1-9.0)	27.8%	(24.8-31.0)
300% - 399%	20.4%	(18.8-22.1)	4.8%	(4.0-5.6)	23.5%	(20.1-27.2)
400% or higher	14.9%	(14.0-15.9)	2.3%	(2.0-2.6)	15.3%	(13.4-17.4)
Education (main caregiver)						
College/other post-HS	19.7%	(19.0-20.5)	4.5%	(4.1-4.9)	22.7%	(21.1-24.5)
High school or GED	36.6%	(35.0-38.2)	12.7%	(11.7-13.7)	34.7%	(32.4-37.1)
Less than high school	36.1%	(33.5-38.7)	12.1%	(10.8-13.6)	33.7%	(30.2-37.4)
Family type						
2-parent bio/adopted	21.8%	(21.0-22.6)	4.5%	(4.2-4.9)	20.8%	(19.4-22.3)
2-parent step/blended	42.1%	(39.1-45.1)	14.7%	(12.9-16.6)	34.8%	(31.0 -
1-parent, mother only	32.6%	(30.9-34.3)	13.4%	(12.2-14.7)	41.2%	(38.1-44.3)
All others	35.9%	(32.6-39.3)	15.0%	(12.9-17.4)	41.9%	(36.2-47.8)
Adult smoking prevalence (TUS-CPS)						
Lowest (12.4-16.4%)	21.0%	(19.3-22.9)	3.4%	(2.8-4.1)	16.2%	(13.3-19.5)
Mid-low (16.5-18.5%)	24.5%	(23.0-26.0)	6.3%	(5.4-7.2)	25.6%	(22.6-29.0)
Middle (18.6-20.6%)	26.8%	(25.6-28.0)	8.1%	(7.4-8.9)	30.3%	(27.8-32.8)
Mid-high (20.7-22.5%)	29.5%	(28.3-30.8)	10.6%	(9.7-11.5)	35.8%	(33.3-38.4)
Highest (22.9-28.2%)	34.9%	(33.7-36.2)	14.2%	(13.2-15.3)	40.7%	(38.4-43.1)
Smokefree Air legislation						
Strong (36-40)	23.5%	(22.1-25.0)	5.2%	(4.6-5.9)	22.2%	(19.7-24.9)
Adequate (29-35)	25.4%	(24.5-26.4)	6.9%	(6.3-7.6)	27.2%	(25.1-29.4)
Inadequate (0-21)	28.7%	(27.8-29.6)	9.8%	(9.2-10.4)	34.2%	(32.4-36.0)

Descriptive analysis – children living with smokers

Sample characteristics

The population characteristics of children living with smokers differ from the overall child population in several ways (Table 11). More than half were living in low income households, compared to slightly less than 40 percent of all children in the U.S. More were living in step/blended, single mother, or other less common types of families than overall, and their parents were less likely to have any education or training beyond high school.

Children living in households with smokers are a little older than the U.S. child population. The subpopulation's racial and ethnic composition includes fewer Hispanic children, matched by an increased proportion of children who are White and non-Hispanic. The proportion of African American non-Hispanic children is essentially the same as in the overall population. Together, these three groups account for 90 percent of both the U.S. child population and the subpopulation of children living with smokers. Within the remaining ten percent, proportionately fewer other-race children and more multi-racial children live in households with smokers.

Children living with smokers are more likely to live in states with higher adult smoking prevalence and in states with Inadequate Smokefree Air laws.

TABLE 12. Descriptive characteristics, overall U.S. child population and subpopulation of children living with smokers, 2007 National Survey of Children's Health

	U.S. children age 0-17				U.S. children age 0-17, smoker in household			
	Percent	*(95% C. I.)*	*Population*	*Count*	*Percent*	*(95% C.I.)*	*Population*	*Count*
Child's Age								
0 - 5 years	33.2%	(32.4 - 34.0)	24,268,968	27,376	32.7%	(31.2 - 34.3)	6,266,088	6,252
6 - 11 years	32.4%	(31.7 - 33.2)	23,738,263	27,590	31.5%	(30.1 - 33.1)	6,036,525	6,607
12 - 17 years	34.4%	(33.6 - 35.2)	25,147,997	36,004	35.7%	(34.3 - 37.2)	6,839,331	9,524
Mean age (years)	8.57	(8.5 - 8.7)	--	--	8.73	(8.6 - 8.9)	--	--
Child's race/ethnicity								
White NH	55.6%	(54.7 - 56.4)	40,654,910	61,343	58.0%	(56.3 - 59.6)	11,098,099	14,972
Hispanic (any race)	20.3%	(19.5 - 21.1)	14,819,832	11,518	17.5%	(16.0 - 19.1)	3,342,750	2,592
Black NH	14.1%	(13.5 - 14.6)	10,285,690	8,863	14.6%	(13.6 - 15.7)	2,791,525	2,349
Multi-racial NH	4.3%	(3.9 - 4.6)	3,118,308	4,327	5.8%	(5.0 - 6.7)	1,108,449	1,331
Other race NH	4.7%	(4.3 - 5.2)	3,461,898	3,988	3.2%	(2.7 - 3.8)	615,539	937
Unknown	1.1%	(1.0 - 1.3)	814,590	931	1.0%	(0.7 - 1.3)	185,582	202
Primary household language								
English	86.8%	(86.0 - 87.5)	63,465,028	84,381	90.6%	(89.3 - 91.8)	17,342,688	21,270
Not English	13.2%	(12.5 - 13.9)	9,623,460	6,534	9.4%	(8.2 - 10.7)	1,790,049	1,102
Unknown	0.1%	(0.1 - 0.2)	66,740	55	0.0%	(0.0 - 0.2)	9,207	11
Household income (% FPL*)								
Less than 100%	18.6%	(17.9 - 19.3)	13,585,478	10,859	26.2%	(24.8 - 27.6)	5,015,705	4,242
100% - 199%	21.0%	(20.3 - 21.7)	15,331,946	15,466	27.2%	(25.8 - 28.6)	5,202,937	5,224
200% - 299%	17.8%	(17.2 - 18.4)	13,004,190	16,450	19.5%	(18.2 - 20.8)	3,728,944	4,557
300% - 399%	13.3%	(12.8 - 13.9)	9,761,018	14,154	10.4%	(9.6 - 11.3)	1,990,192	3,063
400% or higher	29.4%	(28.6 - 30.1)	21,472,597	34,041	16.7%	(15.7 - 17.9)	3,204,167	5,297

* Federal Poverty Level guidelines based on household income and number in household

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TABLE 12. Descriptive characteristics, overall U.S. child population and subpopulation of children living with smokers, 2007 National Survey of Children's Health

	U.S. children age 0-17				U.S. children age 0-17, smoker in household			
	Percent	*(95% C. I.)*	*Population*	*Count*	*Percent*	*(95% C.I.)*	*Population*	*Count*
Education (main caregiver)								
College/other post-HS	61.1%	(60.3 - 61.9)	44,700,035	64,162	46.1%	(44.5 - 47.7)	8,825,324	12,159
High school or GED	25.7%	(25.0 - 26.4)	18,793,836	18,559	35.9%	(34.4 - 37.4)	6,871,850	7,047
Less than high school	12.7%	(12.1 - 13.4)	9,291,849	7,834	17.5%	(16.2 - 18.9)	3,351,524	3,083
Unknown	0.5%	(0.4 - 0.6)	369,508	415	0.5%	(0.3 - 0.7)	93,246	94
Family type								
2-parent bio/adopted	67.7%	(66.9 - 68.4)	49,509,913	63,948	56.4%	(54.8 - 58.0)	10,798,745	12,960
2-parent step/blended	7.6%	(7.1 - 8.1)	5,548,681	6,509	12.2%	(11.2 - 13.3)	2,334,993	2,712
1-parent, mother only	18.7%	(18.0 - 19.3)	13,657,698	14,684	23.3%	(22.0 - 24.6)	4,452,306	4,702
All others	5.9%	(5.5 - 6.3)	4,308,955	5,726	8.1%	(7.2 - 9.1)	1,545,182	1,988
Unknown	0.2%	(0.1 - 0.3)	129,982	103	0.1%	(0.0 - 0.1)	10,718	21
Adult smoking prevalence (TUS-CPS)								
Lowest (12.4-16.4%)	28.1%	(27.3 - 28.9)	20,563,384	17,825	22.6%	(20.9 - 24.3)	4,320,615	3,485
Mid-low (16.5-18.5%)	23.4%	(22.9 - 24.0)	17,126,637	17,740	21.9%	(20.6 - 23.2)	4,189,981	4,102
Middle (18.6-20.6%)	19.9%	(19.5 - 20.3)	14,575,319	19,804	20.4%	(19.4 - 21.4)	3,901,851	4,737
Mid-high (20.7-22.5%)	14.3%	(14.0 - 14.6)	10,470,420	17,870	16.1%	(15.4 - 17.0)	3,091,406	4,605
Highest (22.9-28.2%)	14.2%	(14.0 - 14.5)	10,419,468	17,731	19.0%	(18.2 - 19.9)	3,638,091	5,454
Smokefree Air legislation								
Strong (36-40)	37.9%	(37.2 - 38.6)	27,721,836	19,426	34.0%	(32.4 - 35.7)	6,516,758	4,371
Adequate (29-35)	16.8%	(16.5 - 17.1)	12,303,646	30,243	16.3%	(15.6 - 17.1)	3,128,855	6,918
Inadequate (0-21)	45.3%	(44.6 - 45.9)	33,129,746	41,301	49.6%	(48.1 - 51.1)	9,496,331	11,094

Smokefree air categories

The relative distribution of states with Strong, Adequate, or Inadequate smokefree indoor air legislation by statewide adult smoking prevalence is shown in Table 13. None of the states with Inadequate legislation are in the quintile for lowest adult smoking prevalence. Of states with strongest smokefree air laws, none are in the Mid-high quintile and only one each is in the Middle and High quintiles for adult smoking prevalence.

TABLE 13. Adult smoking prevalence quintile by smokefree air category

Statewide adult smoking prevalence (quintiles)	Strength of state smokefree air legislation 1 Strong	2 Adequate	3 Inadequate
1 Lowest	CA FL HI MA NJ	CT DC ID MD UT	
2 Mid-Low	AZ DE NY RI	CO MT NV	NH TX VA
3 Middle	WA	GA ND OR	IL KS MN MS NE NM PA
4 Mid-High		LA ME SD VT	AL IA MI NC SC WI
5 Highest	OH	AR OK	AK IN KY MO TN WV WY

Overall prevalence of smokefree homes among children living with smokers is significantly lower among children living in states with Inadequate smokefree air legislation, compared to the other two groups. This pattern holds for many of the subpopulations, with some exceptions (Table 14).

Among African American non-Hispanic children, significant difference was not detected between the prevalence of smokefree homes overall and in any of the smokefree

air categories. These children also had the lowest prevalence of smokefree homes each of the three smokefree air groups.

For several other groups there was little difference between Strong and Adequate states in prevalence of smokefree homes. These include older children, White non-Hispanic children, those with household income between 100% and 299% of Federal Poverty Level, children in non-English speaking households, and those living with both biological parents.

Two subgroups revealed patterns that were different than expected. Among children of "Other" race and non-Hispanic, prevalence of smokefree homes is much lower in states with Adequate smokefree coverage, than in Strong states, lower even than in states with Inadequate laws. The opposite is true among children in two of the adult smoking prevalence quintiles. Those in Adequate states are more likely to live in smokefree homes if the states they live in are also in the second lowest or the highest state adult smoking prevalence quintiles.

TABLE 14. Prevalence of smokefree homes among U.S. children living with smokers by strength of state smokefree air legislation, overall and within demographic subgroups, 2007 National Survey of Children's Health

			Strength of smokefree air legislation in child's state of residence					
	ALL STATES		**Strong (36-40 points)**		**Adequate (29-35 points)**		**Inadequate (0-21 points)**	
	Percent	*(95% C.I.)*	*Percent*	*(95% C.I.)*	*Percent*	*(95% C.I.)*	*Percent*	*(95% C.I.)*
Total overall prevalence	71.0%	(69.7 - 72.4)	77.8%	(75.1 - 80.4)	72.9%	(70.6 - 75.0)	65.8%	(64.0 - 67.6)
Child's Age								
0 - 5 years	81.2%	(79.1 - 83.2)	85.6%	(81.3 - 89.1)	81.8%	(77.8 - 85.3)	78.1%	(75.0 - 80.8)
6 - 11 years	71.0%	(68.6 - 73.4)	80.5%	(75.9 - 84.4)	70.1%	(66.0 - 73.9)	65.2%	(61.9 - 68.4)
12 - 17 years	61.7%	(59.4 - 64.0)	68.5%	(63.3 - 73.2)	66.6%	(63.1 - 70.0)	55.4%	(52.4 - 58.3)
Child's race/ethnicity								
White NH	70.8%	(69.1 - 72.4)	75.1%	(71.2 - 78.6)	77.6%	(75.3 - 79.7)	66.2%	(64.1 - 68.3)
Hispanic (any race)	88.4%	(86.0 - 90.4)	91.9%	(88.5 - 94.4)	86.1%	(81.1 - 89.9)	84.4%	(80.2 - 88.0)
Black NH	49.9%	(46.1 - 53.7)	51.5%	(42.2 - 60.7)	48.9%	(42.0 - 55.9)	49.4%	(44.6 - 54.2)
Multi-racial NH	69.6%	(63.0 - 75.4)	78.5%	(66.2 - 87.2)	69.9%	(60.6 - 77.8)	60.4%	(52.4 - 68.0)
Other race NH	81.8%	(76.1 - 86.5)	89.8%	(80.9 - 94.9)	69.0%	(60.3 - 76.5)	78.5%	(66.6 - 87.0)
Primary household language								
English	68.8%	(67.4 - 70.2)	75.0%	(71.9 - 77.8)	71.4%	(69.1 - 73.6)	64.1%	(62.2 - 65.9)
Not English	92.9%	(89.9 - 95.1)	95.4%	(91.8 - 97.5)	93.8%	(87.1 - 97.1)	89.4%	(82.6 - 93.8)
Household income (% FPL*)								
LT 100% FPL	62.9%	(60.0 - 65.8)	70.9%	(64.3 - 76.7)	63.2%	(58.2 - 68.1)	58.6%	(54.9 - 62.2)
100% - LT 200%	67.5%	(64.7 - 70.2)	71.8%	(65.7 - 77.3)	70.6%	(65.9 - 74.9)	63.9%	(60.2 - 67.4)
200% - LT 300%	72.2%	(69.0 - 75.2)	79.1%	(72.0 - 84.7)	76.9%	(72.2 - 81.1)	65.5%	(61.3 - 69.4)
300% - LT 400%	76.5%	(72.8 - 79.9)	84.7%	(77.7 - 89.8)	79.7%	(74.8 - 83.8)	69.8%	(64.4 - 74.8)
400% or higher	84.7%	(82.6 - 86.6)	88.7%	(84.7 - 91.7)	83.8%	(80.1 - 86.9)	81.2%	(78.1 - 83.8)

* Federal Poverty Level guidelines based on household income and number in household

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TABLE 14. Prevalence of smokefree homes among U.S. children living with smokers by strength of state smokefree air legislation, overall and within demographic subgroups, 2007 National Survey of Children's Health

			Strength of smokefree air legislation in child's state of residence					
	ALL STATES		**Strong (36-40 points)**		**Adequate (29-35 points)**		**Inadequate (0-21 points)**	
	Percent	*(95% C.I.)*	*Percent*	*(95% C.I.)*	*Percent*	*(95% C.I.)*	*Percent*	*(95% C.I.)*
Education (main caregiver)								
College/other post-HS	77.3%	(75.5 - 78.9)	82.9%	(79.4 - 85.9)	79.5%	(76.8 - 82.0)	72.7%	(70.3 - 75.0)
High school or GED	65.3%	(62.9 - 67.6)	72.5%	(67.1 - 77.4)	68.5%	(64.7 - 72.0)	59.7%	(56.6 - 62.7)
Less than high school	66.3%	(62.6 - 69.8)	74.5%	(67.1 - 80.7)	66.6%	(59.9 - 72.7)	60.2%	(55.4 - 64.9)
Family type								
2-parent bio/adopted	79.2%	(77.7 - 80.6)	84.1%	(81.3 - 86.5)	82.2%	(79.6 - 84.5)	74.6%	(72.5 - 76.6)
2-parent step/blended	65.2%	(61.1 - 69.0)	73.8%	(64.4 - 81.4)	66.1%	(59.8 - 71.9)	59.9%	(54.6 - 65.0)
1-parent, mother only	58.8%	(55.7 - 61.9)	66.6%	(59.4 - 73.0)	59.7%	(54.4 - 64.7)	54.3%	(50.3 - 58.2)
All others	58.1%	(52.2 - 63.8)	67.9%	(53.7 - 79.4)	62.8%	(55.8 - 69.3)	48.6%	(42.7 - 54.6)
Adult smoking prevalence quintile								
Lowest (12.4-16.4%)	83.8%	(80.5 - 86.7)	85.6%	(81.7 - 88.8)	74.6%	(70.9 - 78.0)	0.0%	n/a
Mid-low (16.5-18.5%)	74.4%	(71.0 - 77.4)	72.5%	(67.7 - 76.8)	80.6%	(76.0 - 84.4)	74.3%	(68.5 - 79.3)
Middle (18.6-20.6%)	69.7%	(67.2 - 72.2)	85.8%	(78.1 - 91.1)	75.9%	(69.8 - 81.1)	66.0%	(62.9 - 68.9)
Mid-high (20.7-22.5%)	64.2%	(61.6 - 66.7)	0.0%	n/a	69.1%	(64.6 - 73.3)	63.2%	(60.3 - 66.1)
Highest (22.9-28.2%)	59.3%	(56.9 - 61.6)	55.4%	(49.0 - 61.5)	62.3%	(58.4 - 66.1)	60.5%	(57.9 - 63.1)

Logistic regression analysis – children living with smokers

Univariate analysis

In univariate analysis, all of the covariates are significantly associated with the likelihood of having a smokefree home. The homes of children whose primary household language is not English are six times as likely to be smokefree, compared to those in English-speaking homes. Other groups most strongly associated with smokefree home environments are children under the age of six, Hispanic children, and children living in the 10 states with lowest adult smoking prevalence. Strong inverse associations were observed for children in poverty level and low-income households, whose odds of having a smokefree home are 60 to 70 percent lower than children in the highest income category. African American non-Hispanic children and children in step- or single parent families were also much less likely to live in smokefree homes.

Multivariate analysis

In the main effects model all of the covariates remain statistically significant (Table 13). No changes in direction of associations were observed. Several possible interactions were noted as variables were added to the model. Interaction terms for these were examined after the main effects model was constructed (see next section).

About half of the univariate effect size for children from non-English households is accounted for by other characteristics in the multivariable model. To a lesser extent, the same is true for many other subgroups. Odds ratios for the age groups are not affected by controlling for other characteristics. The result of this is that in the multivariable model odds ratios for age (less than 6) and household language (not English) are comparable,

and among those with strongest positive associations with the outcome of having a smokefree home. Hispanic children and children living in states with low adult smoking prevalence also have odds ratios higher than 2.0.

Among those least likely to live in smokefree homes are the lower income groups, African American children, and children from "Other" family types. The dose-response pattern observed earlier within adult smoking prevalence, income, and age groups, is evident in the multivariable model as well.

The smokefree air legislation indicator was strongly affected by introduction of variable for smoking prevalence. In the main effects model the p-value for the variable is highly significant, but the beta coefficient for the highest level of Smokefree Air legislation is not statistically significant in the Main Effects model. The middle (Adequate) category is stable.

TABLE 15. Crude and adjusted odds of having a smokefree home, U.S. children living with smokers, 2007 National Survey of Children's Health

			p-value				p-value	
	Unadjusted OR (95% CI)		*β*	*Wald*	*Adjusted OR (95% CI)*		*β*	*Wald*
Child's age				< 0.001				< 0.001
0 - 5 years	2.70	(2.28 - 3.19)	< 0.001		2.86	(2.39 - 3.41)	< 0.001	
6 - 11 years	1.54	(1.32 - 1.79)	< 0.001		1.53	(1.32 - 1.78)	< 0.001	
12 - 17 years	1.00	Ref.	.		1.00	Ref.	.	
Child's race-ethnicity				< 0.001				< 0.001
White NH	1.00	Ref.	.		1.00	Ref.	.	
Hispanic (any race)	3.17	(2.52 - 3.98)	< 0.001		2.31	(1.71 - 3.11)	< 0.001	
Black NH	0.41	(0.35 - 0.49)	< 0.001		0.54	(0.45 - 0.66)	< 0.001	
Multi-race NH	0.95	(0.70 - 1.28)	0.728		0.88	(0.65 - 1.17)	0.370	
Other race NH	1.87	(1.31 - 2.68)	0.001		1.29	(0.90 - 1.86)	0.170	
Primary household language				< 0.001				< 0.001
English	1.00	Ref.	.		1.00	Ref.	.	
Not English	5.99	(4.00 - 8.97)	< 0.001		2.89	(1.71 - 4.89)	< 0.001	
Household income level				< 0.001				< 0.001
LT 100% FPL	0.31	(0.25 - 0.37)	< 0.001		0.40	(0.32 - 0.50)	< 0.001	
100% - LT 200%	0.38	(0.31 - 0.46)	< 0.001		0.44	(0.36 - 0.54)	< 0.001	
200% - LT 300%	0.47	(0.37 - 0.58)	< 0.001		0.52	(0.42 - 0.65)	< 0.001	
300% - LT 400%	0.58	(0.45 - 0.75)	< 0.001		0.63	(0.49 - 0.81)	< 0.001	
400% or higher	1.00	Ref.	.		1.00	Ref.	.	
Education level (main parent/caregiver)				< 0.001				< 0.001
College/other post-HS	1.00	Ref.	.		1.00	Ref.	.	
High school or GED	0.55	(0.48 - 0.64)	< 0.001		0.67	(0.58 - 0.78)	< 0.001	
Less than high school	0.58	(0.48 - 0.70)	< 0.001		0.59	(0.49 - 0.73)	< 0.001	

*Federal Poverty Level guidelines based on household income and number in household

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TABLE 15. Crude and adjusted odds of having a smokefree home, U.S. children living with smokers, 2007 National Survey of Children's Health

			p-value				p-value	
	Unadjusted OR (95% CI)		*β*	*Wald*	*Adjusted OR (95% CI)*		*β*	*Wald*
Family type				< 0.001				< 0.001
2-parent bio/adopted	1.00	Ref.	.		1.00	Ref.	.	
2-parent step/blended	0.49	(0.40 - 0.60)	< 0.001		0.77	(0.64 - 0.94)	0.008	
1-parent, mother only	0.38	(0.33 - 0.44)	< 0.001		0.61	(0.51 - 0.73)	< 0.001	
All others	0.37	(0.28 - 0.47)	< 0.001		0.52	(0.40 - 0.67)	< 0.001	
Adult smoking prevalence quintile				< 0.001				< 0.001
Lowest (12.4-16.4%)	3.56	(2.78 - 4.57)	< 0.001		2.31	(1.76 - 3.03)	< 0.001	
Mid-low (16.5-18.5%)	1.98	(1.63 - 2.41)	< 0.001		1.44	(1.16 - 1.78)	0.001	
Middle (18.6-20.6%)	1.58	(1.35 - 1.84)	< 0.001		1.43	(1.22 - 1.68)	< 0.001	
Mid-high (20.7-22.5%)	1.23	(1.06 - 1.42)	0.006		1.29	(1.10 - 1.51)	0.002	
Highest (22.9-28.2%)	1.00	Ref.	.		1.00	Ref.	.	
Smokefree air laws				< 0.001				0.005
Strong (36-40)	1.82	(1.54 - 2.16)	< 0.001		1.17	(0.96 - 1.42)	0.123	
Adequate (29-35)	1.39	(1.22 - 1.59)	< 0.001		1.32	(1.14 - 1.53)	< 0.001	
Inadequate (0-21)	1.00	Ref.	.		1.00	Ref.	.	
Cox and Snell Pseudo R-Square								*0.156*

Interaction terms

Several possible interactions were observed during development of the main effects model: race/ethnicity with household language, family type, adult smoking prevalence, and household income; household income with age, family type, and education level; and adult smoking prevalence with the measure of state smokefree air legislation. Interaction terms were created for these and also for the remaining combinations of race/ethnicity, income level, and smokefree air measure with the other covariates. A total of 22 two-way interaction terms were evaluated. After testing these individually in the main effects model, twelve were eliminated because the adjusted Wald F and beta coefficients had p-values greater than 0.05. The remaining ten terms were added simultaneously to the main effects model and removed one by one until $p<0.05$ for all of the remaining terms in the model. Three interaction terms were retained: adult smoking prevalence quintile with smokefree air laws, race-ethnicity with smokefree air laws, and race-ethnicity with primary household language.

Smokefree air laws and adult smoking prevalence

Significant positive associations with smokefree home environments were observed for children living in states with Strong smokefree air laws and adult smoking prevalence in the lowest and middle quintiles. Children living in states with Adequate smokefree air provisions are more likely to live in smokefree homes if adult smoking prevalence in their state of residence falls within the middle or mid-high quintiles. In mid-low states this relationship nears statistical significance.

Smokefree air laws and race-ethnicity

No significant effects of Strong smokefree air legislation were observed within race-ethnicity subpopulations. However, in states with Adequate smokefree air provisions, non-Hispanic non-White children living with smokers are more than twice as likely to be exposed to SHS in their homes, compared to White non-Hispanic children in such states. The association is highly significant among Black non-Hispanic children ($p<0.001$), but is also significant for non-Hispanic children of other minority races. Among Hispanic children in states with Adequate laws, the odds of having a smokefree home are 40 percent lower than the reference groups, contradicting our overall findings that children of Hispanic ethnicity are less likely to be exposed to SHS in their homes.

Race-ethnicity and primary household language

A finding of borderline significance yet still noteworthy is that Hispanic children whose household language is not English are more than five times as likely to live in smokefree homes as their English speaking counterparts. Among Black non-Hispanic children living with smokers, the odds of having a smokefree home are much higher for those whose household language is not English, compared to children in English-speaking homes. Because the odds ratio and confidence interval estimates are unusually large, we examined these groups more closely (see Appendix). Our analysis established that the inflated estimates resulted from a small number of respondents who are Black and from non-English speaking households, of whom a few were assigned exceptionally large weighting values during statistical adjustments made to correct for sampling bias.

TABLE 16. Final model with interaction terms: Smokefree homes, children living with smokers, 2007 National Survey of Children's Health

	Adjusted OR (95% CI)		p-value β	p-value Var
Child's age				< 0.001
0 - 5 years	2.90	(2.43 - 3.46)	< 0.001	
6 - 11 years	1.54	(1.32 - 1.79)	< 0.001	
12 - 17 years	1.00		.	
Child's race-ethnicity				0.006
White, non-Hispanic	1.00		.	
Hispanic (any race)	2.06	(1.41 - 3.00)	< 0.001	
Black, non-Hispanic	0.67	(0.53 - 0.84)	0.001	
Multi-racial, non-Hispanic	0.85	(0.58 - 1.23)	0.376	
Other race, non-Hispanic	1.84	(1.06 - 3.20)	0.030	
Primary household language				0.002
English	1.00		.	
Not English	0.77	(0.13 - 4.37)	0.764	
Household income level				< 0.001
LT 100% FPL	0.40	(0.32 - 0.50)	< 0.001	
100% - LT 200%	0.44	(0.35 - 0.54)	< 0.001	
200% - LT 300%	0.52	(0.42 - 0.65)	< 0.001	
300% - LT 400%	0.64	(0.50 - 0.81)	< 0.001	
400% or higher	1.00		.	
Education level (main parent/caregiver)				< 0.001
College or other post-HS	1.00		.	
High school or GED	0.67	(0.58 - 0.78)	< 0.001	
Less than high school	0.58	(0.48 - 0.71)	< 0.001	
Family type				< 0.001
2-parent bio/adopted	1.00		.	
2-parent step/blended	0.76	(0.63 - 0.92)	0.006	
1-parent, mother only	0.61	(0.51 - 0.73)	< 0.001	
All others	0.50	(0.39 - 0.66)	< 0.001	
Adult smoking prevalence quintile				< 0.001
Lowest (12.4-16.4%)	1.76	(1.32 - 2.33)	< 0.001	
Mid-low (16.5-18.5%)	1.33	(0.96 - 1.85)	0.081	
Middle (18.6-20.6%)	1.11	(0.92 - 1.33)	0.280	
Mid-high (20.7-22.5%)	1.09	(0.91 - 1.31)	0.336	
Highest (22.9-28.2%)	1.00		.	

* Federal Poverty Level guidelines based on household income and number in household

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TABLE 16. Final model with interaction terms: Smokefree homes, children living with smokers, 2007 National Survey of Children's Health

	Adjusted OR (95% CI)		p-value β	p-value Var
Smokefree air laws				0.015
Strong (36-40)	0.87	(0.65 - 1.16)	0.340	
Adequate (29-35)	1.29	(1.02 - 1.62)	0.032	
Inadequate (0-21)	1.00		.	
Adult smoking prevalence / Smokefree air laws				0.001
Lowest (12.4-16.4%)				
Strong	1.73	(1.05 - 2.85)	0.030	
Adequate	1.00		.	
Inadequate				
Mid-low (16.5-18.5%)				
Strong	1.14	(0.70 - 1.85)	0.600	
Adequate	1.54	(0.97 - 2.46)	0.069	
Inadequate	1.00		.	
Middle (18.6-20.6%)				
Strong	3.56	(1.84 - 6.89)	< 0.001	
Adequate	1.83	(1.24 - 2.71)	0.002	
Inadequate	1.00		.	
Mid-high (20.7-22.5%)				
Strong				
Adequate	1.53	(1.10 - 2.13)	0.012	
Inadequate	1.00		.	
Highest (22.9-28.2%)				
Strong	1.00		.	
Adequate	1.00		.	
Inadequate	1.00		.	
Child's race-ethnicity / Smokefree air laws				0.003
White, non-Hispanic				
Strong	1.00		.	
Adequate	1.00		.	
Inadequate	1.00		.	
Hispanic (any race)				
Strong	1.19	(0.67 - 2.13)	0.548	
Adequate	0.60	(0.35 - 1.00)	0.051	
Inadequate	1.00		.	

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TABLE 16. Final model with interaction terms: Smokefree homes, children living with smokers, 2007 National Survey of Children's Health

	Adjusted OR (95% CI)		p-value β	p-value Var
Black, non-Hispanic				
Strong	0.74	(0.44 - 1.24)	0.249	
Adequate	0.48	(0.32 - 0.71)	< 0.001	
Inadequate	1.00		.	
Multi-racial, non-Hispanic				
Strong	1.14	(0.55 - 2.38)	0.725	
Adequate	0.79	(0.44 - 1.43)	0.433	
Inadequate	1.00		.	
Other race, non-Hispanic				
Strong	1.18	(0.42 - 3.27)	0.754	
Adequate	0.43	(0.21 - 0.86)	0.017	
Inadequate	1.00		.	
Child's race-ethnicity / Primary household language				0.012
White, non-Hispanic				
English	1.00		.	
Not English	1.00		.	
Hispanic (any race)				
English	1.00		.	
Not English	5.51	(0.90 - 33.61)	0.065	
Black, non-Hispanic				
English	1.00		.	
Not English	67.66	(4.14 - 1,106.80)	0.003	
Multi-racial, non-Hispanic				
English	1.00		.	
Not English	2.68	(0.19 - 37.35)	0.464	
Other race, non-Hispanic				
English	1.00		.	
Not English	1.35	(0.18 - 10.08)	0.771	
Cox and Snell Pseudo R Square				*0.164*

Model fit

Cox and Snell Pseudo R-Square statistic indicate that that approximately 15.6 percent of the variation in the outcome is accounted for by the main effects model. Addition of

the three two-way interaction terms to the final model improves the fit slightly, to 16.7 percent.

Summary of results

The prevalence of smokefree home environments for children in states with Strong smokefree legislation is 77.8 percent, significantly higher than the prevalence for children in states with Adequate laws (72.9%), which is in turn significantly higher than for those in states with Inadequate laws (65.8%). This pattern holds true across all subpopulation characteristics examined, except for race-ethnicity groups and adult smoking prevalence quintiles. Compared to children in states with Inadequate smokefree air laws, children in states with Adequate and Strong laws are respectively 39 percent and 82 percent more likely to have smokefree home environments, before adjusting for other characteristics.

When we evaluated the smokefree air legislation measure in a multivariate model the effects of both Adequate and Strong laws remained statistically significant when adjusted for demographic characteristics only (OR 1.51, 95% CI: 1.27-1.79, for children in states with Strong legislation, and OR 1.49, 95% CI: 1.30-1.71 for those in states with Adequate laws). After introduction of state adult smoking prevalence into the model, the effect of Strong legislation is smaller and no longer statistically significant (p=.123), indicating an interaction. For Adequate legislation there is little change (OR 1.32, 95% CI: 1.14-1.53).

The final model with interactions reveals that the strongest associations for smokefree legislation with smokefree home rules are found among states in the middle (OR 3.56, 95% CI: 1.84-6.89) and lowest (OR 1.73, 95% CI: 1.05-2.85) quintiles for adult smoking prevalence. Results for children living in states with Adequate state laws are significant

for middle and mid-high prevalence states and borderline (p=0.69) for states with mid-low prevalence.

Our analysis suggests that among Black children and their families, state smokefree air legislation has little influence on smoking behaviors in the home. We find much lower prevalence of smokefree homes among Black children living with smokers, when compared to other racial and ethnic groups. Prevalence is low among Black children regardless of whether the state they live in has Strong, Adequate, or Inadequate smokefree indoor air legislation. In fact, the likelihood of having a smokefree home for children living in states rated as Adequate is half that of children living in states with Inadequate or no smokefree air legislation.

DISCUSSION

How prevalent is parent-reported secondhand smoke exposure among children in the U.S.?

Living with a tobacco smoker

We estimate that in 2007 26.2 percent of children in the U.S. were living in households that include tobacco smokers. Two earlier studies using the MEPS survey yielded slightly higher estimates. Based on data collected in 2004, Machlin et al report prevalence at 31.0 percent (Machlin, Hill, & Liang, November 2006). King and colleagues combined MEPS data for 2000-2004, estimating overall prevalence of living with a smoker at 34.4 percent for children 0-18 years of age (King, et al., 2009). Table 17 compares NSCH results for comparable subgroups with these two MEPS studies.

NSCH estimates run between one and six percentage points below the 2004 estimates. This is not unexpected, considering the overall decline in adult smoking prevalence, but might also reflect some underreporting in the NSCH.

Smoking occurs in home or complete smoking ban – all children

As expected, the population prevalence of SHS exposure as measured by serum cotinine concentration in the NHANES is considerably higher than estimates derived from the NSCH and other surveys that rely on interview questions. According to data from the 2007-2008 NHANES 53.6 percent of all children age 3-11 and 46.5 percent of youth age 12-19 have serum cotinine at or above the exposure threshold of 0.05ng/ml (Centers for Disease Control and Prevention, 2010). Use of biomarkers reflects exposure from all sources combined and does not distinguish between household SHS and other

exposure sources. The fact that the prevalence of elevated serum cotinine concentration is so much higher than can be accounted for by household smoking suggests that children still receive significant amounts of exposure in locations other than the home. This idea is supported by the nationwide Social Climate Survey of Tobacco Control (SCS-TC), which in 2008 asked parents about their children's exposure to SHS over the past seven days in the home and also in the family car, in the homes and cars of relatives and friends, in indoor public places, and in other public places (McMillen, Klein, Tanski, Winickoff, & Hill, 2009). Altogether, 42 percent of parents reported their children were exposed in one or more of the seven locations asked about, a result much closer to the prevalence estimated by NHANES measurements.

TABLE 17. Prevalence of living with a smoker, NSCH and MEPS studies

	NSCH	**Machlin, 2006[1]**	**King, 2009[2]**
	2007	*2004*	*2000-04*
Overall	26.2	31.0	34.4
Age of child			
Age-0-5	25.8	26.7 (0-4)	32.5
Age 6-11	25.4	31.6 (5-11)	34.0
Age 12-17	27.2	33.6	36.4 (12-18)
Race/ethnicity			
White NH[3]	27.3	33.9	36.4
Black NH[3]	27.1	30.7	36.1
Hispanic	22.6	23.9	27.5
Household Income Level			
< 100% FPL[4]	36.9	40.2	49.4
100-199% FPL[4]	33.9	35.9	--
200-299% FPL[4]	28.7	--	--
300-399% FPL[4]	20.4	--	--
> 400%: FPL[4]	14.9	21.6	21.3
Education			
< High School	36.1	--	--
HS Grad only	36.6	--	--
> High School	19.7	24.8	--

[1]Source: (Machlin, Hill, & Liang, November 2006)
[2]Source: (King, et al., 2009)
[3]NH – Non-Hispanic
[4]FPL – Federal Poverty Level income guidelines

2007 NSCH estimates of the overall prevalence of SHS inside children's homes are lower than estimates from several other national interview surveys conducted at about the same time. Our estimate of 4.8 percent prevalence among children age 0-5 is low compared to the 2005 National Health Interview Survey (NHIS) finding that 8.4% of children ages 0-6 live in homes where someone smokes regularly (Federal Interagency Forum on Child and Family Statistics, 2011). More recently, a CDC report from the National Health and Nutrition Examination Survey (NHANES) indicates that in 2007-2008 18.2 percent of children age 3-11 and 17.1 percent of 12-19 year olds were living in homes in which residents smoke regularly (Centers for Disease Control and Prevention, 2010). In spite of the fact that our age groups do not map exactly to those reported in this study, it is evident that the NSCH estimates are much lower (4.8% of children age 0-5, 7.4% of age 6-11, and 10.4% of age 12-17 years).

A study based on the 2006/07 TUS-CPS found that 83.9 percent of households with children under 18 prohibit smoking inside the home (Hawkins & Berkman, 2011), which, when converted to prevalence of in-home SHS of 16.1 percent, is more than twice the NSCH estimate of 7.6 percent. This difference may be accounted for in part by the fact that the TUS-CPS question about home smoking policies was asked for all households including those with no smokers. If we were to assume that the proportion of non-smoking households with no-smoking rules is the same in the NSCH as in the TUS-CPS, the population prevalence rate for the NSCH would rise to 12.3 percent.

These differences may be attributable to methodology. While data for the NSCH is collected during a 20-30 minute telephone interview with one family member, the NHIS and NHANES use in-person interviews, sometimes with multiple household members.

Studies have shown that face-to-face interviews yield higher prevalence estimates for smoking than telephone surveys (Blumberg, Luke, & Cynamon, 2006) and that this difference is accounted for by higher prevalence of smoking among adults whose homes do not have landline telephone service (Arday, et al., 1997).

Another possible influence is social desirability. Parents may be more reluctant to admit to smoking or permitting smoking inside the home when the subject is their child, as in the NSCH, rather than themselves or other adults in the household, as in the BRFSS, TUS-CPS, NHANES and NHIS.

In 2008 another nationwide telephone survey, the Social Climate Survey of Tobacco Control (SCS-TS) reported that 17.6 percent of parents do not prohibit smoking inside the home (McMillen, Klein, Tanski, Winickoff, & Hill, 2009). Yet when asked whether their children have been exposed to SHS in the home within the past 7 days, 8.6% of all parents say yes. Our observation that the NSCH estimates of children living with a smoker are less divergent from those reported from other surveys than estimates of homes in which smoking occurs is consistent with findings of a study of the 1998-99 TUS-CPS, which found that, compared to non-smokers, smokers tend to underestimate smoking exposure (Mumford, Levy, & Romano, 2004).

Smoking occurs in home or complete smoking ban –living with smokers

The two studies from the 2006/07 TUS-CPS report slightly different estimates of the prevalence of smokefree rules among households with smokers: 55.8 percent (Hawkins & Berkman, 2011) and 50.0 percent (Mills, White, Pierce, & Messer, 2011), both considerably lower than the NSCH estimate of 71.0 percent in this population. The SCS-TS is also similar to the TUS-CPS, with 53.5 percent prevalence (McMillen, Klein,

Tanski, Winickoff, & Hill, 2009). This, again, might be due in part to the fact that the NSCH asks about smoking behavior in the home, while the other two surveys ask about household rules. It is certain that in some undetermined number of households residents do not smoke indoors even though the family does not have an explicit rule against doing so.

The study conducted by Mills, White, Pierce, & Messer (2011) reported prevalence of smokefree homes among selected subgroups, shown below in comparison with results from the NSCH (Table 16). The differential is larger for these estimates than for the prevalence of living with a smoker, yet the patterns within subgroups are similar, suggesting that relationships between subgroups are similar despite the difference in magnitude.

TABLE 18. Prevalence of smokefree rules among households with both smokers and children under 18, NSCH and TUS-CPS

	NSCH	**TUS-CPS[1]**
	2007-08	*2006-07*
Overall	71.0	50.0
Race/ethnicity		
African-American	49.9	32.8
Asian/Pacific Islander		65.9
Hispanic	88.4	72.2
Non-Hispanic White	70.8	48.0
Education		
< High school	66.3	41.1
High school graduate	65.3	42.9
< High school	77.3	54.3/63.8
Age youngest child		
0-5	81.2	58.7
6-11	71.0	43.2
12-17	61.7	40.3

[1]Source: (Mills, White, Pierce, & Messer, 2011)

Is the risk of in-home secondhand smoke exposure among children living in smoking households related to the presence of Strong smokefree air legislation, and how does this relationship vary across demographic subgroups?

State smokefree indoor air legislation

In univariate analysis we find a significant overall association between the presence of Strong or Adequate smokefree air legislation and smokefree homes among children living with smokers. Our multivariate model confirms this finding and suggests that the effects of such legislation are moderated by social attitudes toward smoking (approximated by adult smoking prevalence) and by cultural contexts of children and their families. Both of these factors have previously been identified in the literature, but in slightly different contexts.

Social attitudes toward smoking

Similar to the Mills study cited previously (Mills, White, Pierce, & Messer, 2011), we used state-level adult smoking prevalence as a proxy for smoking-related social norms. We detected a strong interaction between state smokefree air legislation and social norms based on smoking prevalence. The effects of smokefree air laws are strongest in the middle quintile, where the odds of having a smokefree home among children living in states with Adequate and Strong laws are 83 percent and 256 percent higher, respectively, than for children in states with Inadequate legislation. We found smaller but still significant effects for Strong legislation for children living in the ten states with the lowest smoking prevalence (OR 1.73, p=0.030), and for Adequate legislation among those in states with mid-high (fourth quintile) smoking prevalence (OR 1.53, p=0.012).

Our observations are generally consistent with a recent study of the association between smokefree air legislation (state and local) and smokefree home rules among adults in the U.S. (Cheng, Glantz, & Lightwood, 2011), despite differences in the population studied and the anti-smoking sentiment indicator used. This research finds that a measure of antismoking sentiment based on questions in the TUS-CPS, decreases the effects of local and state smokefree air laws in both smoking and non-smoking households.

Race-ethnicity and household language

Hispanic children and children in non-English speaking households fare better than others in our study, which supports the conclusion that Hispanic ethnicity is a protective factor. Although not highly significant, if household language serves as a proxy for acculturation, our findings reflect those of a 2006 study of Mexican and Mexican American women with young children (Gonzales, Malcoe, Kegler, & Espinoza, 2006) and from a study of Koreans in California, that SHS exposure is less common among children in families that have recently come to the U.S.

The Mills study, which focuses on smoking rules in households with and children and smokers, uses a measure of state-level adult smoking prevalence stratified by race as a proxy for anti-smoking social norms (Mills, White, Pierce, & Messer, 2011). This study observed little association between smokefree home rules and smoking prevalence among African American households with smokers and children. Similarly, we observed no differences in the prevalence of smokefree homes between states with Strong, Adequate, and Inadequate smokefree air laws. However, we also observed that Black children in states with Adequate smokefree air provisions are half as likely to have a smokefree

home as Black children living in states with Inadequate legislation (OR 0.48, $p<0.01$). The same is true for other non-White, non-Hispanic children (OR .043, $p=0.017$) and, surprisingly, Hispanic children, though significance of this estimate is borderline (OR 0.60, $p=0.51$). For children living in states with Strong legislation, these relationships are not statistically significant. This suggests the possibility that factors not in our model, have some influence on the results. These might be characteristics that the two groups of states differ on, such as urban-rural, or racial diversity.

Health disparities

Family and household characteristics associated with high levels of stress are influential in our analysis. Poverty and lack of post-high school education or training are likely correlated with additional stressors such as poor physical and mental health, unstable or less than optimal housing, child care issues, occupational hazards, and legal problems. These, in turn, often impede parents' efforts to maintain good health habits. In our study, we identified strong inverse relationships between smokefree homes and low or poverty level income and parents' lack of education or training beyond high school. These associations were somewhat diminished in the multivariate model.

Family structures that may indicate levels of past or present stress from difficult relationships and changes in income, support systems, and living situations are associated with reduced likelihood of living in a smokefree home. In the case of single mother households, simple logistics may be a stronger influence than social norms or state legislation. Other studies have shown that children in households that include adults other than parents are more likely to be exposed to SHS (King, et al., 2009).

Age gradient

We observed a strong and persistent relationship between age and SHS exposure. This is consistent with the literature, in which the age of the youngest child is associated with the presence of smokefree home rules (Hawkins & Berkman, 2011; Soliman, Pollack, & Warner, 2004). The medical profession and public health have succeeded in raising awareness of the risks of smoking during pregnancy and motivating women to avoid smoking and secondhand exposure for the sake of their infants. It follows that these attitudes tend to carry over into early childhood and beyond. As children mature and become more independent, parental influence is increasingly displaced by peers, media, advertising other influences that do not necessarily have a stake in the health of young people. At the same time, parents respond to children's growing ability to care for their own needs by easing their control of the child's environment.

Limitations and Strengths

Limitations

Our study is subject to several limitations. The cross-sectional design of the NSCH does not permit assessment of the direction of associations. As a result, we cannot infer causality based on whether household smoking behaviors occurred before or after state legislation was implemented.

A second limitation is that we did not use multilevel modeling for this analysis. Similarities and differences between states are complex, and our findings do not take into account the influence of state-level variation. Further studies should be conducted using these methods.

The absence of sub-state identifiers in NSCH restricts our ability to control for possible effects of within-state variation in smokefree laws, which in some areas could overshadow the impact of state-level legislation. Sub-state data for the NSCH are available through the NCHS Research Data Center; however, the time and expense required to access these data are beyond the scope of the current study.

Of the households with children contacted for the NSCH, 66.0 percent completed the survey. However, the overall response rate as a proportion of telephone numbers selected is 46.7% or 51.2%, depending on how unresolved telephone numbers are taken into account. The low rate is thought to be largely attributable to an overall trend away from personal and household landline-based telephone service (Blumberg, Luke, & Cynamon, 2006). Until recently little difference was observed between households with no phone service and those with service interruptions, which permitted adjustment of weights among the latter to approximate characteristics of the former in the study population. As the recent trend in cell phone substitution grows, this sort of adjustment becomes less effective. During NSCH data collection in 2007-2008, the trend toward cell phone substitution was in its early stages and it was possible to use this adjustment. In addition, raking adjustments were performed in order to bring weighted totals into alignment with state child population characteristics. These adjustments are especially critical for research on smoking behaviors because this is one area in which the prevalence tends to be higher among individuals without telephone coverage (Blumberg, Luke, & Cynamon, 2006).

Measurement of outcome and covariates

The NSCH data collection format is a 20-30 minute telephone interview. Parents responses to questions about smoking are not verified using biomarker or other measurement. We expect that this would result in misclassification of some households with smokers as having no smokers and, similarly, misclassification in some cases of households in which smoking occurs as smokefree. However, studies comparing parent reported SHS exposure to measurement of hair or serum cotinine concentration found acceptable agreement (Wilkinson, Arheart, & Lee, 2006; Wakefield, et al., 2000). Studies comparing the responses of multiple informants have raised concerns about reliance on individual reports of smoking behaviors and home smoking rules (Ding, et al., 2011; Mumford, Levy, & Romano, 2004). A recent article examining the prevalence of discordant reports on home smoking bans found that the percentage of discordant reports from the TUS-CPS decreased significantly between 1995 (12.7%) and 2007 (2.8%) (Zhang, Martinez-Donate, Kuo, & Jones, 2012), suggesting reduced potential for this bias in the 2007 NSCH.

The NSCH questionnaire does not ask about details or intent associated with household smoking behaviors. A smokefree rule is inferred if no smoking occurs inside home, and non-exposure is inferred if no household members are smokers. The identity of household members who smoke is not known, nor is the number of smokers, the frequency, or number of cigarettes. No information about in-home smoking behaviors is obtained for children not living with smokers. Wong et al (2002) found that asking additional questions did not improve the ability to predict SHS exposure as measured by serum cotinine. Other studies report that the level of exposure, whether expressed in

terms of smoking behaviors or biomarkers, is much lower in non-smoking household than in households that include smokers (Schuster, Franke, & Pham, 2002; Hawkins & Berkman, 2011).

The state-level adult smoking prevalence measure used in this study serves as a proxy for social norms and anti-smoking sentiment, which we were not able to measure directly. It has been suggested elsewhere that adult smoking prevalence differs between ethnic and racial groups (Mills, White, Pierce, & Messer, 2011). Additional research using adult smoking prevalence stratified by race and ethnicity might be enlightening.

Several different methods have been used to measure the strength of smokefree air legislation. Our coding scheme was derived from the system used in the ALA State of Tobacco Control reports, which we modified slightly for this analysis. Other studies have used other methods, which may rely on different views of the scope and strength of state smokefree legislation. Also, because we did not use sub-state identifiers, we were unable to account for county and municipal smokefree air regulations.

The 2006 ALA State of Tobacco Control report includes legislation implemented before January 1, 2007, four months before data collection for the 2007 NSCH began. It is possible that in some states not enough time had passed for the full impact of smokefree air legislation to be felt throughout the state.

Finally, this study focuses on legislation restricting smoking in public places, which is only one among four areas reported in the ALA State of Tobacco Control reports. This type of legislation is intended to be one component of a comprehensive effort designed to address all aspects of tobacco use and secondhand smoke exposure, in which results of the various components support and strengthen one another.

Strengths

The major strength of this study is its use of the 2007 National Survey of Children's Health. The NSCH is a nationally representative sample of children in the United States, sponsored by the U. S. Maternal and Child Health Bureau and conducted by the National Center for Health Statistics of the Centers for Disease Control and Prevention. The large sample size, over 91,000 respondents, facilitates complex statistical analyses of national level data.

Because records in the NSCH are weighted to reflect child population characteristics in each state and the District of Columbia, results are generalizable at state and national levels, and population estimates may be obtained. The validity of the NSCH is maximized by high-level quality control in all phases of the survey, including complex sampling design, strong data collection methods, and sophisticated procedures for weighting and adjustment to minimize sampling and non-response bias.

Data from the NSCH supplement existing measures of household tobacco use. The tobacco use questions included in the NSCH dovetail with information collected by other national surveys. The state-specific weighting of NSCH data offers the potential for multilevel modeling to highlight the contribution of local and state-level influences.

The NSCH, unlike many national surveys with data on household tobacco used, is focused on children and families. As such, it offers a view of children's SHS exposure that is enriched by the many factors specific to children, their families, and their health care experiences.

CONCLUSION

Summary of findings

State smokefree air legislation is associated with the likelihood of smokefree home environments among U.S. children who live with smokers. This association is subject to social norms regarding smoking, as indicated by state-wide prevalence of smoking among adults, and is strongest among states with moderate or low proportions of adult smokers.

We observed an incremental relationship between the strength of smokefree air legislation and prevalence of smokefree homes among all subpopulations with the exception of Black non-Hispanic children. Among Black children who live with smokers the prevalence of smokefree homes is much lower than among other race and ethnicity groups, and does differ significantly between children living in states with Strong, Adequate, or Inadequate smokefree air legislation.

An inverse relationship between smokefree homes and living in states with Adequate smokefree air laws occurs within Black and Other Race non-Hispanic child subpopulations. Yet among children living in states with Strong smokefree air legislation this relationship is not statistically significant.

Among children living with smokers, the odds of having a smokefree home nearly three times as high for children under six years of age, compared to those between 12 and 17 years old. Characteristics associated with socioeconomic disparities – low household income, lack of education, and disrupted families – are also associated with lower likelihood of having a smokefree home.

Public health implications

Despite overall success at reducing the prevalence of active and passive smoking, millions of children are still being exposed to SHS in their homes every day. The primary setting in which children are exposed is the home, where children spend most of their time. For children who live with smokers, especially, the home represents an environment of continued and concentrated exposure.

SHS in the home cannot be sufficiently controlled by using ventilation, air cleaning, or limiting smoking activity to certain areas or times. The most effective means of eliminating SHS exposure is a complete ban on smoking activity inside the home. The prevalence of smokefree homes in the U.S. continues to climb. States with well-established clean indoor air legislation are seeing the largest increases.

Our study, like others, demonstrates an association between state-level clean indoor air legislation and higher prevalence of smokefree homes, an outcome that promises substantial reduction of SHS exposure among children. Reduced SHS exposure in children translates to reductions in incidence of childhood asthma, respiratory infections, otitis media, and over time, heart and lung disease and other health problems in adulthood. Fewer children will begin smoking in adolescence, and parents who smoke may find it possible to cut down or quit altogether.

When viewed in combination with the findings of Mills, Cheng, and others, we are confident that the association we observed between state-level policies and smokefree homes is real and not an artifact of survey methodology. The relatively large effect even when controlling for plausible confounders, supports the notion of a causal association and argues for co-benefits.

Recommendations

We recommend further study of this topic using MLM methods to examine the interplay between state-level and individual level factors, and expanding the model to include relevant health care access and quality characteristics such as insurance type, family centered care, and presence of a medical home.

Our findings are in accordance with those of Mills and others regarding household smoking behaviors among African American families. Patterns of exposure among Black non-Hispanic children are distinctly different from other groups. Additional research into the dynamics of smoking behaviors and attitudes among African Americans is essential as a foundation for supporting change in this population.

After decades of successful efforts to reduce SHS exposure, the U.S. has hit a plateau, with little gain since 2002. Those who have not responded to the call for healthy air are concentrated within economically and socially disadvantaged populations. The strong role that social determinants play in continued SHS exposure calls for re-examination of and retooling of public health strategies to increase their effectiveness in areas of highest high risk. Some efforts in this direction have already been initiated. Legislation restricting smoking in hospitality venues such as restaurants, freestanding bars, hotels and motels, and entertainment venues, is promising because of the large number of low income and minority workers they employ. Recent initiatives to reduce smoking in rental housing (it is legal for owners to ban in most states) may help to protect children in lower SES and minority groups (Tanski & Wilson, 2012). These efforts must be supported and supplemented in a renewed and comprehensive initiative.

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APPENDIX

Unweighted and weighted counts: Primary household language by Race-ethnicity

In the Final Model with Interactions, results of the interaction term for primary household language and race-ethnicity included a beta coefficient that was exceptionally high. Examination of cell counts in the interaction revealed a small number of cases with exceedingly disparate case weight values among Black children in non-English households (Table A1, bold type).

TABLE A1. Smoking in home (smoker in household) by race-ethnicity and language

	No SHS inside home		Smoking inside home		Total	
	Raw N	*Weighted N*	Raw N	*Weighted N*	Raw N	*Weighted N*
White Non-Hispanic						
Not English	82	*71,111*	14	*21,006*	96	*92,117*
English	10,693	*7,767,850*	4,153	*3,219,823*	14,846	*10,987,673*
Total	10,775	*7,838,961*	4,167	*3,240,829*	14,942	*11,079,790*
Hispanic (any race)						
Not English	755	*1,378,253*	66	*74,148*	821	*1,452,401*
English	1,362	*1,565,807*	392	*310,167*	1,754	*1,875,974*
Total	2,117	*2,944,060*	458	*384,315*	2,575	*3,328,375*
Black Non-Hispanic						
Not English	**9**	***19,400***	**2**	***314***	**11**	***19,714***
English	1,174	*1,368,019*	1,149	*1,395,581*	2,323	*2,763,600*
Total	1,183	*1,387,419*	1,151	*1,395,895*	2,334	*2,783,314*
Multi-racial NH						
Not English	9	*8,854*	2	*1,579*	11	*10,433*
English	937	*760,849*	378	*334,300*	1,315	*1,095,149*
Total	946	*769,703*	380	*335,879*	1,326	*1,105,582*
Other race NH						
Not English	125	*158,887*	17	*26,593*	142	*185,480*
English	611	*344,703*	182	*84,564*	793	*429,267*
Total	736	*503,590*	199	*111,157*	935	*614,747*
Total all race-ethnicity						
Not English	980	*1,636,505*	101	*123,640*	1,081	*1,760,145*
English	14,777	*11,807,228*	6,254	*5,344,435*	21,031	*17,151,663*
Total	15,757	*13,443,733*	6,355	*5,468,075*	22,112	*18,911,808*

Within this group, the odds of having a smokefree home using the weighted values would be: , compared to using the unweighted counts. The category for Multi-racial children has the same raw counts, but using the weighted values, the odds for this group are: , much closer to the unweighted estimate. We conclude that the finding is true, but that the magnitude of the effect may not be reliable.