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Secondhand smoke and asthma: What are the effects on healthcare utilization among children?

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ABSTRACT

Objective. This study aims to examine the associations between asthma, secondhand smoke exposure and healthcare utilization in a nationally representative sample of children.

Methods. Data from 5686 children aged 0–11 years were analyzed. Healthcare utilization, asthma diagnosis and demographic information came from the 2001 and 2006 Medical Expenditure Panel Surveys. Secondhand smoke exposure was measured during the 2000 and 2005 National Health Interview Surveys. Multivariable regression models were used to determine the association between secondhand smoke exposure, asthma diagnosis and healthcare utilization (hospitalizations, emergency department visits, outpatient visits and prescription medication use).

Results. Asthma modified the relationship between secondhand smoke exposure and hospitalizations, as exposure more than doubled the odds of hospitalization among children with asthma but had no effect on children without asthma. Secondhand smoke exposure increased the odds by 37% of emergency room visits ($P < 0.001$), but was not associated with outpatient visits or medication use. Children with asthma had a higher odds of utilizing all healthcare services ($P < 0.001$).

Conclusions. Secondhand smoke exposure was associated with a greater utilization of hospitals and emergency departments, and the effect on hospitalizations was most pronounced among children with asthma. Reducing secondhand smoke exposure would help to reduce the burden on the healthcare system, especially among children with asthma.

Introduction

Secondhand smoke exposure is known to cause adverse health outcomes among both children and adults (Bek et al., 1999; Boldo et al., 2010; U.S. Department of Health and Human Services, 2006). This association can be characterized as a dose–response relationship, with no minimum threshold for risk (Giovino, 2007). Children are more vulnerable to the negative effects of secondhand smoke, as their immune systems are not well developed (Schwartz, 2004). Childhood asthma has been repeatedly linked to secondhand smoke exposure (Burke et al., 2012; Elliot et al., 1998; Neuman et al., 2012; Palmer et al., 2006). Asthma prevalence has been increasing among children (CDC, 2011) and many studies have linked maternal smoking during pregnancy and secondhand smoke exposure during early childhood with asthma (Burke et al., 2012; Elliot et al., 1998; Neuman et al., 2012).

Children exposed to secondhand smoke appear to utilize the healthcare system at a greater rate (Florence et al., 2007; Hill and Liang, 2008; Levy et al., 2011; McBride et al., 1998). Hill and Liang (2008) provided evidence that secondhand smoke exposure increased the number of inpatient hospitalizations and emergency department visits. Levy et al. (2011) found that Medicaid-enrolled children who lived with smokers had increased healthcare costs, but after covariate adjustment this effect disappeared. Interestingly, Florence et al. (2007) found a negative association between household smoke exposure and any healthcare use among children. The inconsistent results may be due to differences in self-report versus medical provider reported outcome measures or the possibility that children who are exposed to indoor smoke may be less likely to access medical care. Given these inconsistent results, further research is needed to understand the association between secondhand smoke exposure and healthcare utilization.

While the results linking secondhand smoke exposure to increased healthcare utilization have been mixed, the evidence for asthma is consistent, with several studies demonstrating that asthma increases healthcare spending (Kamble and Bharmal, 2009; Lozano et al., 1999). The major contributors to the increased costs of asthma treatment are prescription medications and physician office visits.

Few studies have examined how secondhand smoke exposure influences asthma-related healthcare utilization. In a small study of children from one health maintenance organization, McBride et al. (1998) reported that children exposed to secondhand smoke were not more

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likely to purchase asthma-related prescriptions. Another study found that children who were exposed to secondhand smoke were less likely to use asthma-related healthcare services (Crombie et al., 2001).

Given the increasing trend of asthma prevalence among children and the substantial burden of secondhand smoke exposure, understanding the effects of secondhand smoke exposure, combined with asthma, on healthcare utilization is needed (Bek et al., 1999; Boldo et al., 2010; Braman, 2006; Giovino, 2007; U.S. Department of Health and Human Services, 2006). The objectives of this study were to examine the associations between asthma, secondhand smoke exposure and healthcare utilization in a nationally representative sample of children. Specifically, we wanted to determine whether the effect of secondhand smoke exposure on healthcare utilization was modified by asthma status. That is, is secondhand smoke exposure worse for children with asthma than for children without asthma or does it affect all children equally when examining healthcare utilization?

Methods

Data sources

In the current study, the sample consisted of children aged 0 to 11 years who were included in Panel 6, 2001 and Panel 11, 2006 of the Medical Expenditure Panel Survey (MEPS) Household Component (HC) (Agency for Healthcare Research and Quality, 2004, 2008). The MEPS is a national survey designed to collect information related to healthcare utilization and expenditures among the civilian, non-institutionalized household population in the US and is funded by the Agency for Healthcare Research and Quality (AHRQ).

Each year, the sample of the MEPS HC is drawn from the households that responded to the National Health Interview Survey (NHIS) in the previous year (Ezzati-Rice TM and Greenblatt, 2008). The 2000 and 2005 NHIS data were linked to the 2001 Panel 6 and 2006 Panel 11 MEPS respectively (Agency for Healthcare Research and Quality, 2012). The MEPS uses an overlapping and ongoing panel design to collect data and the sampled households were interviewed five times during a two-year period (Ezzati-Rice TM and Greenblatt, 2008). We used the data from the first year of the MEPS HC follow-up. The MEPS HC provides data on demographics, health conditions, and use of healthcare from a representative national sample.

Measures

The primary outcome variables were healthcare utilization variables. These included hospital stays, emergency department visits, ambulatory visits, and prescription medications. The outcomes of interest are important indicators of children's health conditions and health burden in terms of utilization and expenditures. Annual healthcare utilization data were collected during the household interviews and from the medical providers. To ensure the completeness of data, the MEPS data set included imputed utilization data in the public use data set. In the current study, use of healthcare services reflects the annual average of 2001 and 2006.

The two primary independent variables of interest were (1) exposure to secondhand smoke in the home and (2) asthma diagnosis. Secondhand smoke exposure was measured by the family member's reporting of smoking inside the home. Although parental smoking status information was available in the MEPS HC, we focused on smoking inside the home; therefore, we used the information collected in the NHIS. In the 2000 NHIS Cancer Module, the selected adult was asked how many days anyone smoked inside the home during the past week. In the 2005 NHIS, the sampled adult was asked whether or not the residents of the household smoked inside home. The household smoking variable had missing data for 24% of 7482 eligible children due to the following reasons: 1) 0.9% of respondents refused or did not know how to answer the NHIS household smoking question; 2) 3.7% of sampled adults did not have their smoking behavior measured in the NHIS; and 3) 8.1% of adults in the NHIS data failed to link to MEPS. Because the data were mostly missing by the failure of linking the two surveys, it was less likely that the missing values were related to household smoking behavior. Therefore, children without complete information on secondhand smoke exposure were excluded from the further analysis. Thus, household smoke exposure was divided into two categories: 1) no smoking inside the home and 2) any smoking inside the home.

Childhood asthma was measured during the MEPS HC interview. During the interview, a knowledgeable family member was selected and asked whether or not the child had been diagnosed with asthma by a physician.

The potential confounders included characteristics of the child and family, and survey year. Child characteristics included age, race, gender, census region, urban or rural residence, and insurance type. Family characteristics included the family income as a percentage of the federal poverty level, household size, parental asthma history, and parental education level. Survey year was included in the model to adjust for the variability caused by pooling two years of data.

Data analysis

Descriptive statistics were calculated for the sample, by household smoking status. To examine the association between secondhand smoke exposure and asthma on healthcare utilization, multivariable logistic regression models were fit for each utilization outcome. Each healthcare utilization measure was treated as a binary outcome variable. The interaction between household smoking status and asthma diagnosis was first tested at the alpha $= 0.05$ level. If the interaction was not significant, then separate main effect models were fit. To estimate the effect of asthma, the model adjusted for secondhand smoke and other relevant covariates described in the previous paragraph. To estimate the effect of secondhand smoke exposure, asthma was not included in the model, since it may be on the causal pathway between secondhand smoke and healthcare utilizations. Odds ratios (ORs), percent attributable risk (%ARs), and 95% confidence intervals (CIs) were calculated. All the statistical analyses were weighted using the personal weights, and the other survey design features (strata and clustering) were accounted for in the models. The statistical analyses were conducted using the survey functions in Stata 12.0 (Stata Corporation, College Station, TX).

Results

Table 1 summarized characteristics of children in the study by secondhand smoke exposure ($n = 5686$). Among children with complete information on smoking status, approximately 31.5% lived with at least one smoker in the household, and about 18.4% were exposed to secondhand smoke inside their homes during the previous year. Among households with in-home smoking, there was a greater prevalence of children who were African American, non-Hispanic, enrolled in public insurance or uninsured, and a greater prevalence of families with low parental education and income compared to homes with no smoking. In addition, children exposed to in-home smoking had higher average numbers of hospital stays and emergency department visits, but fewer ambulatory visits. The average number of hospitalizations was very small, given the data cluster at 0. While the overall prevalence of asthma was 10% in the sample, the prevalence was lower (9.5%) in homes where there was no smoking compared to homes in which there was smoking (10.8%), although the result was not statistically significant. Children with missing data had similar demographic characteristics, childhood asthma prevalence, and healthcare utilization as children with complete data; however, insurance status differed.

Table 2 contains the model information for the outcome inpatient hospitalization stays. As the results suggest, there was a positive interaction between secondhand smoke exposure and asthma ($P = 0.03$). Among children without asthma, the estimated effect of secondhand smoke exposure was not significant at 0.05 level (OR $= 1.10$, 95% CI 0.84 to 1.49). However, among asthmatic children, the odds of having hospital stays among children exposed to household tobacco smoke were 2.18 times the odds among those who were not exposed (95% CI 1.29 to 3.67). The attributable risk was estimated to be 54.1% (95% CI 22.5% to 72.8%).

In the models examining emergency department visits, ambulatory visits and prescription medications, the interaction between secondhand smoke exposure and asthma was not significant. Therefore, Table 3 contains the results from the models fit to examine the main effects of secondhand smoke exposure and asthma, separately.

For emergency department visits, we found that both childhood asthma and secondhand smoke exposure were positively associated with the use of emergency department services. Having asthma was