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Healthcare costs attributable to secondhand smoke exposure at home for U.S. adults

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ABSTRACT

Objective: To estimate healthcare costs attributable to secondhand smoke (SHS) exposure at home among nonsmoking adults (18 +) in the U.S.

Methods: We analyzed data on nonsmoking adults (N = 67,735) from the 2000, 2005, and 2010 (the latest available data on SHS exposure at home) U.S. National Health Interview Surveys. This study was conducted from 2015 to 2017. We examined hospital nights, home care visits, doctor visits, and emergency room (ER) visits. For each, we analyzed the association of SHS exposure at home with healthcare utilization with a Zero-Inflated Poisson regression model controlling for socio-demographic and other risk characteristics. Excess healthcare utilization attributable to SHS exposure at home was determined and multiplied by unit costs derived from the 2014 Medical Expenditures Panel Survey to determine annual SHS-attributable healthcare costs.

Results: SHS exposure at home was positively associated with hospital nights and ER visits, but was not statistically associated with home care visits and doctor visits. Exposed adults had 1.28 times more hospital nights and 1.16 times more ER visits than non-exposed adults. Annual SHS-attributable healthcare costs totaled $4.6 billion (including $3.8 billion for hospital nights and $0.8 billion for ER visits, 2014 dollars) in 2000, $2.1 billion (including $1.8 billion for hospital nights and $0.3 billion for ER visits) in 2005, and $1.9 billion (including $1.6 billion for hospital nights and $0.4 billion for ER visits) in 2010.

Conclusions: SHS-attributable costs remain high, but have fallen over time. Tobacco control efforts are needed to further reduce SHS exposure at home and associated healthcare costs.

1. Introduction

Secondhand smoke (SHS) exposure has been linked to numerous health conditions, including stroke, respiratory illness, lung cancer, and heart disease for adults (U.S. Department of Health and Human Services, 2014; American Cancer Society, n.d.; California Air Resources Board, 2005); and ear infections, asthma, respiratory symptoms, respiratory infections (bronchitis and pneumonia), sudden infant death syndrome (SIDS), and attention deficit hyperactivity disorder (ADHD) for children.(U.S. Department of Health and Human Services, 2014; Department of Health and Human Services (US), 2006; Max et al., 2013) The harmful health effects of SHS exposure have resulted in excess economic costs. In the U.S., several state-level studies have been conducted to estimate the economic impact of SHS exposure. In Maryland, the economic costs of adult illness and premature death attributable to SHS exposure amounted to $523.8 million in 2005 (Waters, 2006). In Minnesota, the total annual cost of treatment for SHS-related diseases among children and adults was $228.7 million in 2008 dollars, which amounted to $44.58 per resident (Waters et al., 2009). In North Carolina, the total annual cost of treatment for health conditions related to SHS exposure among children and adults was estimated to be $293.3 million in 2009 dollars (Plescia et al., 2011). In Indiana, the direct cost of health care and premature loss of life attributed to SHS among adults and children was estimated to be $1.3 billion in 2010, resulting in SHS-related costs of $201 per capita (Saywell et al., 2013). In California, the SHS-attributable healthcare costs among children and adults totaled over $241 million in 2009 (Max et al., 2015). Internationally, one study estimated that the total healthcare costs of SHS exposure at home among nonsmoking adults (aged 19 +) in rural China amounted to $1.2 billion in 2011, which represents 0.3% of China's national healthcare expenditures in 2011 (Yao et al., 2015). Another study estimated that direct and indirect costs of SHS exposure totaled $126 million among adults aged 35 and older in Taiwan in 2010, representing 0.03% of Taiwan's gross domestic product (Sung et al., 2014).

National-level studies on the economic impact of SHS exposure are

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limited in the U.S. One study estimated the total annual SHS-attributable medical cost in the U.S. at $6.9 billion in 2005 (Behan et al., 2005). Another study reported that SHS exposure resulted in > 42,000 deaths, nearly 600,000 years of potential life lost, and $6.6 billion of lost productivity in 2006 in the U.S. (Max et al., 2012). A study estimated that the costs incurred by society for illnesses and deaths due to SHS exposure among never-smoking adults who lived in U.S. public housing range from $87 - $135 million depending on how sensitive a biomarker was used to detect exposure in 2011 (Mason et al., 2015).

Due to the success in implementing smoke-free policies beginning in the early 2000s (Americans Nonsmokers' Rights Foundation, 2015), the prevalence of SHS exposure in the United States has been declining substantially since 2000 (Homa et al., 2015). Using data from the National Health and Nutrition Examination Surveys (NHANES), a recent Centers for Disease Control and Prevention (CDC) report found that the percentage of the U.S. nonsmoking population (aged ≥ 3 years) with cotinine-measured SHS exposure declined from 52.5% in 1999–2000 to 25.3% in 2011–2012 (Homa et al., 2015). Although progress has been made to implement comprehensive smoke-free laws in indoor workplace and public places in the past two decades (Homa et al., 2015), it is more challenging to restrict smoking at home. As of 2011, 17% of U.S. households did not have 100% smoke-free rules at home (King et al., 2016). Thus, the home setting is still the primary source of SHS exposure for many people (King et al., 2016). Not only do smokers expose people that they live with, but they may also expose people in neighboring units in multi-unit housing, making home smoking an even greater public health issue (Chambers et al., 2015).

To get the attention of the policymakers who may influence the adoption of home smoking rules, it is helpful to quantify the burden of SHS home exposure by estimating the economic cost associated with this exposure. However, none of the national-level cost of SHS studies cited above examined the cost of SHS exposure in the home environment (Behan et al., 2005; Max et al., 2012; Mason et al., 2015). To fill this gap in the literature, this study estimated annual healthcare costs attributable to SHS exposure at home among nonsmoking adults in the U.S. in 2000, 2005 and 2010.

2. Methods

2.1. Data source

This study used two data sources.

2.1.1. National Health Interview Surveys (NHIS)

The NHIS is an annual, nationally representative, in-person survey of households in the civilian, non-institutionalized population in the U.S. In each sampled household, one adult and one child are randomly selected to provide detailed health information. The NHIS Sample Adult and Person files contain information on healthcare utilization and the number of months without any health insurance coverage. In addition, the same randomly selected core NHIS adult participants are asked to participate in a Cancer Control Supplement, which contains detailed questions about tobacco use and SHS exposure at home. The SHS question was asked in this Cancer Control Supplement in 2000, 2005, and 2010 (though not in the latest 2015 NHIS Cancer Control Supplement). We pooled the Sample Adult files, Person files, and Cancer Control Supplement data from 2000, 2005, and 2010 to obtain a large enough sample to analyze the association between SHS exposure and healthcare utilization.

2.1.2. Medical Expenditures Panel Survey (MEPS)

The MEPS is a nationally representative, face-to-face, household interview survey of the U.S. civilian non-institutionalized population conducted annually since 1996. It contains detailed information on each individual's healthcare utilization, expenditures, and the associated ICD-9 diagnostic codes for healthcare services used. It also includes the sources of payment for each medical event, insurance coverage, health status, medical conditions, and sociodemographic characteristics. The most recent MEPS data available when this study was conducted, the 2014 wave, was used to obtain unit costs for healthcare utilizations.

2.2. Study sample

This study was limited to nonsmokers because it is difficult to separate the impact of active and passive smoking for smokers. Nonsmokers were defined as those who had not smoked 100 cigarettes in their lifetime or those who had smoked 100 cigarettes in their lifetime but do not currently smoke.

2.3. Measures

2.3.1. Dependent variables

Four healthcare utilization outcome variables were included in our analysis as dependent variables: the number of nights in the hospital in the past 12 months (hospital nights), the number of home care visits in the past 2 weeks (home care visits), the number of doctor visits in the past 2 weeks (doctor visits), and the number of emergency room visits in the past 12 months (ER visits). These four variables are those that the NHIS includes to query about health utilization.

2.3.2. Primary independent variable

The *primary independent variable* was self-reported SHS exposure at home. Nonsmoking adults were defined as being exposed to SHS at home if they answered “yes” to the NHIS question: “In a usual week, does anyone who lives here, including yourself, smoke cigarettes anywhere inside this home?”, and answered one or more days to the following question: “Usually, about how many days per week do people who live here smoke anywhere inside this home?”.

2.3.3. Other covariates

Socio-demographic characteristics included age (18–34, 35–64, and 65 +), gender (male and female), race and ethnicity (Non-Hispanic (NH) White, NH African American, NH Asian, NH Other, and Hispanic), education (< high school degree, high school graduate/general educational development (GED), some college, and ≥ college degree), and poverty status based on the federal poverty level (FPL) guideline (poor (< 100% FPL), low income (100%–199% FPL), middle income (200%–399% FPL), high income (≥ 400% FPL), and unknown). Because 18.7% of respondents had unknown income status, we included “unknown” as a separate category. The number of months without health insurance was determined by two questions in the NHIS Person file. If the respondent answered “yes” to the question “In the past 12 months, was there any time when you did not have any health insurance or coverage?”, then he/she was asked “In the past 12 months, about how many months were you without coverage?” We also include the survey year as a covariate in the model.

2.4. Final sample size

The pooled 2000, 2005, and 2010 NHIS data contained 68,659 nonsmoking adults. The final study sample contained 67,735 nonsmoking adults after excluding 924 (1.3%) respondents with missing information on education, number of months without insurance, or any of the four healthcare utilization variables.

2.5. Statistical analysis

For each type of healthcare utilization (hospital nights, home care visits, doctor visits, and ER visits), three measures were estimated for all nonsmoking adults and by SHS exposure status during the study period: the mean healthcare utilization per person regardless of having positive