Pediatric Surgery and Parental Smoking Behavior

Yu Shi, M.D., M.P.H.,* David O. Warner, M.D.†

ABSTRACT

Background: Secondhand smoke exposure poses health risks to children, including increased risks for anesthesia. In adult smokers, surgery serves as a teachable moment to motivate quitting. For parents who smoke, having a child undergo surgery may also serve as a teachable moment for smoking behavioral change. This study determined if there is an association between children undergoing a surgical procedure and changes in their parents' smoking behavior.

Methods: Secondary analyses were performed using logistic regression analysis of 2005 survey data from the National Health Interview Survey. Analyses included 9,289 parent respondents who provided information on both themselves and their children.

Results: Of the sampled children, 1,112 (12.6%, 95% CI: 11.7, 13.4) lived in a home with at least one person who smoked inside in a usual week. In multivariate analysis of the relationship between parent and child surgical history in the past 12 months and smoking behavior, surgery in either the parent (odds ratio 2.19, 95% CI: 1.55, 3.08) or child (odds ratio 2.61, 95% CI: 1.56, 4.35) was associated with an increased likelihood of a quit attempt by the parent. However, these attempts were more likely to be successful if the parents (odds ratio 2.35, 95% CI: 1.35, 4.07), not their child (odds ratio 0.51, 95% CI: 0.20, 1.28), had surgery within the past 12 months.

Conclusions: Parents who smoke were more likely to make a quit attempt within the past 12 months if their children had surgery within this time, but they were not more likely to succeed in maintaining abstinence and thus could benefit from assistance.

What We Already Know about This Topic

- Children are especially vulnerable to the effects of secondhand smoke

What This Article Tells Us That Is New

- In a secondary analysis of more than 9,000 children, parents who smoked were more likely to make a quit attempt within the past 12 months if their child had surgery within that time but were not more likely to succeed

DESPITE the implementation of tobacco control measures such as smoking bans in public spaces, at least 1 in 10 nonsmokers in the United States is exposed to secondhand smoke (SHS).[1] Children are especially vulnerable. Because their primary source of exposure is in the home, policies such as public smoking bans are less likely to benefit children. Rather, the smoking behaviors of individual parents are the primary determinants of children's exposure to SHS. The detrimental impacts of SHS on child health are well established.[2] There has been considerable effort directed toward helping parents reduce the exposure of their children to SHS, but current estimates suggest that as many as one in six children in the United States is regularly exposed to SHS in the home.[3,4]

This exposure has consequences to children when they undergo surgery. There is a clear relationship between the level of SHS exposure and the risk of respiratory complications during and after anesthesia.[5–9] The increased frequency of conditions such as middle ear diseases caused by SHS may also make it more likely that children will require surgery (*e.g.*, myringotomy). In adults, smoking by surgical patients increases their risk for respiratory, cardiac, and wound-re-

* Research Fellow, † Professor, Department of Anesthesiology and Nicotine Research Center, Mayo Clinic, Rochester, Minnesota.

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Address correspondence to Dr. Warner: Department of Anesthesiology, Mayo Clinic, 200 First Street Southwest, Rochester, Minnesota 55905. warner.david@mayo.edu. This article may be accessed for personal use at no charge through the Journal Web site, www.anesthesiology.org.

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◆ This article is accompanied by an Editorial View. Please see: Tønnesen H: Surgery and smoking at first and second hand: Time to act. ANESTHESIOLOGY 2011; 115:1–3.

lated complications, such as wound infections.[10] In previous work we have shown that in adult surgical patients the scheduling of elective surgery is an independent factor associated with smoking cessation so that surgery can serve as a "teachable moment" (an event that prompts behavioral change) for smoking behavior.[11] Several attempts have been made to use the diagnosis of childhood illnesses such as asthma or hospitalization for these illnesses as opportunities to intervene with parents who smoke.[12–15] However, it is not known whether child health events such as undergoing a surgical procedure prompt changes in parental smoking behavior (*i.e.*, serve as a teachable moment). Parents reducing the exposure of their children to SHS could reduce their risk of perioperative complications and potentially benefit their long-term health if such reductions could be maintained.

The aim of this study was to determine whether there is an association between children undergoing a surgical procedure and changes in the parents' smoking behavior by secondary analysis of data obtained in a representative cross-sectional health survey of U.S. residents. We tested the hypothesis that parents would be more likely to attempt and succeed in quitting smoking if their child had a recent surgical procedure. As secondary aims we also determined the prevalence of SHS exposure of children undergoing surgery and whether exposure increases child surgical rates.

Materials and Methods

Study Population

The National Health Interview Survey (NHIS) provides information on the health of a national representative sample of the noninstitutionalized population of the United States.[16] A core survey questionnaire is administered annually to approximately 35,000 households by personal interview. Supplemental surveys on specific topics such as cancer control are collected in selected years. This analysis used the NHIS data collected in 2005 because these are the most recent data available that include information on smoking behavior inside the home. One adult and one child (younger than 18 yr) were randomly selected from each household surveyed, with all information obtained from the adult respondents. The child sample was composed of 12,523 children younger than 18 yr. The unconditional response rate for the child sample was 77.5% (86.1% of families responded, and of these, information was provided for 90.1% of eligible children). The 10,551 adult respondents provided information on themselves and the sampled children. Most (92%) of the adults interviewed were the parents of the sampled children and are referred to as "parents" in the remainder of this report. For this analysis, the study population was restricted to adult respondents who provided information on themselves and their children and for whom complete information regarding smoking history was available (n = 9,289). Because this study used publicly available deidentified data, it was exempted from review by the Mayo Clinic Institutional Review Board.

Data Analyzed

The demographic information analyzed included the sex of the sampled child and the respondent parent, the age of the child, the age of the parent, the race and ethnicity of the child and the parent, family income, and the educational attainment of the respondent parent.

The occurrence of surgery within the past year in the sampled child was defined as a positive answer to the question "During the past 12 months has (child name) had surgery or other surgical procedures either as an inpatient or outpatient?" Similar questions determined whether the respondent parent had undergone surgery and whether the sampled child had visited the emergency department within the past 12 months. Two health conditions potentially related to SHS exposure were included in the analysis: asthma and frequent ear infections.

Secondhand smoke exposure in the home was defined as a positive answer to the question "In a usual week, does anyone who lives here, including yourself, smoke cigarettes, cigars, or pipes anywhere inside this home?" The respondent parent was considered to be smoking if they reported smoking every day or some days. For current smokers, intent to quit smoking was defined by a positive answer to the question "Would you like to completely quit smoking cigarettes?" Smokers were regarded as having made a quit attempt if they reported stopping smoking for more than 1 day within the last 12 months because they were trying to quit smoking. Respondents were considered to have successfully quit smoking within the past year if they were former smokers (defined as having ever smoked more than 100 cigarettes and not smoking at all at the time of interview) and they had been quit for less than 1 yr.

Statistical Analysis

All estimates were adjusted for the sampling design used by the NHIS.[16] The NHIS used a multistage sampling procedure designed to represent the civilian noninstitutionalized population of the United States. Each person in the study population had a known nonzero probability of selection. These probabilities of selection, along with adjustments for nonresponse and poststratification, were reflected in the sample weights. In this analysis, the sample weights were taken into account to provide a representative estimate of the general population.

To analyze the relationship between the sampled child undergoing surgery in the past 12 months and parental smoking behavior, three logistic regressions were performed using three different smoking outcomes as dependent variables. For the analysis with intent to quit smoking as the outcome measure, the study population was composed of all respondent parents who were current smokers (n = 1,977). For the analyses with smoking cessation within the past 12 months and quit attempts in the past year as the outcome measures, the study population included the parents who were current smokers and those who had quit during the past year (n = 2,177). The surgical history of the child and sur-

gical history of the parent within the past 12 months were entered into the model separately to estimate univariate associations. The final model included child and parent surgery within the past 12 months and adjusting variables of parent sex, parent age, child age (0–4, 5–11, or 12–17 yr), race and ethnicity of parent, family income, parent education (less than high school, high school or GED [General Educational Development] certificate, or beyond high school), a history of asthma in the child, and a history of frequent ear infections in the child.

Logistic regression models were also used to explore the relationship between SHS and the sampled child having received surgery within the past 12 months. SHS exposure was first entered into the model as a univariate independent variable. Multivariate analysis was then performed, including the sex, age, and race of the child, family income, and parent education. A similar approach was used for any emergency department visit of the sampled child within the previous 12 months as a dependent variable to determine whether another measure of healthcare utilization was affected by SHS exposure.

Analysis was performed using SAS version 9.1 (SAS Institute, Cary, NC). A $P < 0.05$ was considered to be statistically significant.

Results

Table 1 shows the characteristics of the study sample. Among the 9,289 children, 1,977 (21.4%) lived with a respondent parent who smoked, and 1,109 (12.5%) lived in a home with at least one person who smoked inside in a usual week. Of the 1,109 parent respondents who reported that smoking occurred inside the home, this occurred 7 days a week in 842 (79.3%). Of the 2,117 parent respondents who were either current smokers or who had quit during the past year, 1,047 (48.9%) had made at least one quit attempt in the past 12 months, and of these 140 (6.5%) maintained abstinence from the attempt onset to the time of survey (*i.e.*, had successfully quit smoking within the past 12 months). Of the 1,977 current smokers, 1,428 (74.2%) reported that they would like to completely quit smoking cigarettes.

Table 1. Characteristics of Study Sample (n = 9,289)

—	n (%)	95% CI
Child sex, male	4,738 (50.9)	49.7, 52.0
Parent sex, male	3,477 (45.2)	44.0, 46.3
Child age, yr (mean)	8.6	8.5, 8.7
0–4	2,634 (27.7)	26.6, 28.8
5–11	3,410 (38.2)	37.0, 39.3
12–17	3,245 (34.1)	32.9, 35.3
Parent age (mean) (yr)	37.0	36.7, 37.2
Child race/ethnicity	—	—
Non-Hispanic white	4,898 (62.2)	60.8, 63.6
Non-Hispanic black	1,269 (13.1)	12.2, 14.1
Hispanic	2,538 (18.1)	17.0, 19.2
Other	573 (6.6)	5.9, 7.3
Annual family income >$20,000	7,168 (83.4)	82.4, 84.4
Parent education	—	—
< High school	1,860 (17.1)	16.1, 18.2
High school or GED certificate	2,475 (27.4)	26.1, 28.6
> High school	4,898 (55.5)	54.2, 56.9
Current smoking by parent	1,977 (21.4)	20.3, 22.5
Secondhand smoke inside the home	1,109 (12.5)	11.6, 13.4
Parent surgery within 12 months	1,113 (11.8)	11.1, 12.6
Child surgery within 12 months	457 (5.1)	4.6, 5.6

GED = General Educational Development.

Of the 9,289 parent-child pairs analyzed, 1,113 (11.8%) parents and 457 (5.1%) sampled children reported surgery within the past 12 months. Of these, 261 parents (23.5% of those having surgery) were current smokers and 65 children (14.2% of those having surgery) lived in a house with at least one person who smoked inside in a usual week. In the analysis of the relationship between parent and child surgical history during the past 12 months and smoking behavior, surgery in either the parent or child was associated with an increased likelihood of a quit attempt in univariate and multivariate analyses (table 2). However, these attempts were more likely to be successful only if the parents themselves, and not their child, had surgery within the past 12 months. Indeed, child surgery tended to decrease the likelihood of successful quitting, although not significantly, whereas parent surgery more than doubled the odds of success (table 2). In multivariate analysis, other factors related to a higher likelihood of a successful quit attempt by the parent included female sex and having a younger child. For current smokers, surgical history was associated with an increased likelihood of an intent to quit, significantly so for both parent surgery and child surgery. A history of asthma or multiple ear infections in the child was not significantly associated with quit attempts, successful quits, or intent to quit (table 2).

In the analysis of the relationship between SHS exposure and surgical utilization, exposure was not significantly related to the child having surgery within the past 12 months in either univariate or multivariate analysis (table 3). In contrast, SHS exposure was related to a higher likelihood of visiting the emergency department in the previous 12 months in both univariate and multivariate analysis (table 3).

Discussion

The main finding of this study is that parents who smoke cigarettes were more likely to make a quit attempt within the past 12 month if their children had surgery within this time, but they were not more likely to succeed in maintaining abstinence.

In the 2005 NHIS survey, the proportion of sampled children exposed to SHS (12.5%) was consistent with results from other national surveys in the United States. For exam-

Table 2. Univariate and Adjusted Analysis of Factors Associated with Quit Attempts, Successful Quitting, and Intent to Quit

	Univariate OR (95% CI)	*P* Value	Adjusted* OR (95% CI)	*P* Value
Quit Attempts in Past 12 Months				
Child surgery in past 12 months	2.18 (1.42, 3.37)	<0.001	2.61 (1.56, 4.35)	<0.001
Parent surgery in past 12 months	2.16 (1.59, 2.93)	<0.001	2.19 (1.55, 3.08)	<0.001
Parent sex, female	1.31 (1.06, 1.62)	0.012	1.11 (0.89, 1.40)	0.351
Parent age, per 1-yr increase	0.99 (0.97, 1.00)	0.010	0.98 (0.96, 0.99)	<0.001
Parent race, Non-Hispanic white	1.00	—	1.00	—
Non-Hispanic black	1.33 (0.97, 1.81)	0.073	1.30 (0.92, 1.84)	0.136
Hispanic	0.96 (0.75, 1.22)	0.716	1.17 (0.84, 1.61)	0.352
Other	1.21 (0.36, 4.09)	0.761	0.85 (0.22, 3.28)	0.817
Child age, 0–4 yr	1.00	—	1.00	—
5–11 yr	0.76 (0.59, 0.98)	0.034	0.75 (0.56, 1.02)	0.067
12–17 yr	0.80 (0.62, 1.04)	0.095	0.91 (0.65, 1.27)	0.572
Family income	0.95 (0.77, 1.18)	0.664	0.91 (0.70, 1.19)	0.494
Parent education, < High school	1.00	—	1.00	—
High school or GED	1.06 (0.78, 1.44)	0.724	1.18 (0.88, 1.59)	0.278
> High school	1.57 (1.16, 2.14)	0.004	1.74 (1.27, 2.39)	<0.001
History of asthma in child	1.03 (0.80, 1.32)	0.847	0.94 (0.72, 1.23)	0.645
History of multiple ear infections in child	0.90 (0.58, 1.39)	0.630	0.81 (0.51, 1.31)	0.396
Successful Quit in Past 12 Months				
Child surgery in past 12 months	0.80 (0.31, 2.09)	0.651	0.51 (0.20, 1.28)	0.150
Parent surgery in past 12 months	2.22 (1.40, 3.53)	<0.001	2.35 (1.35, 4.07)	0.002
Parent sex, female	1.51 (1.03, 2.21)	0.036	2.04 (1.28, 3.26)	0.003
Parent age, per 1-year increase	0.99 (0.97, 1.00)	0.126	1.00 (0.98, 1.03)	0.786
Parent race, Non-Hispanic white	1.00	—	1.00	—
Non-Hispanic black	0.90 (0.46, 1.79)	0.771	0.85 (0.40, 1.81)	0.668
Hispanic	1.60 (1.02, 2.50)	0.040	1.65 (0.97, 2.81)	0.063
Other	0.44 (0.06, 3.49)	0.440	0.63 (0.07, 5.57)	0.680
Child age, 0–4 yr	1.00	—	1.00	—
5–11 yr	0.55 (0.33, 0.90)	0.016	0.45 (0.24, 0.85)	0.014
12–17 yr	0.51 (0.32, 0.81)	0.005	0.42 (0.21, 0.85)	0.015
Family income	0.95 (0.61, 1.48)	0.817	1.40 (0.84, 2.36)	0.200
Parent education, < High school	1.00	—	1.00	—
High school or GED	0.97 (0.56, 1.69)	0.926	0.85 (0.47, 1.52)	0.578
> High school	1.10 (0.68, 1.79)	0.693	0.76 (0.44, 1.34)	0.351
History of asthma in child	1.14 (0.75, 1.75)	0.543	1.12 (0.61, 2.05)	0.719
History of multiple ear infections in child	0.59 (0.24, 1.43)	0.241	0.47 (0.17, 1.33)	0.153
Intent to Quit (Current Smokers)				
Child surgery in past 12 months	1.40 (0.83, 2.34)	0.204	1.89 (1.02, 3.49)	0.042
Parent surgery in past 12 months	1.51 (1.01, 2.27)	0.047	1.64 (1.03, 2.61)	0.039
Parent sex, female	0.96 (0.76, 1.23)	0.761	0.87 (0.67, 1.14)	0.323
Parent age, per 1-year increase	1.01 (1.00, 1.02)	0.184	1.01 (0.99, 1.03)	0.292
Parent race, Non-Hispanic white	1.00	—	1.00	—
Non-Hispanic black	1.04 (0.69, 1.55)	0.862	1.15 (0.75, 1.78)	0.515
Hispanic	0.52 (0.40, 0.69)	<0.001	0.63 (0.45, 0.89)	0.009
Other	1.08 (0.27, 4.38)	0.913	0.66 (0.15, 2.93)	0.582
Child age, 0–4 yr	1.00	—	1.00	—
5–11 yr	1.06 (0.80, 1.42)	0.688	1.24 (0.82, 1.87)	0.308
12–17 yr	1.08 (0.81, 1.45)	0.587	0.66 (0.15, 2.93)	0.582
Family income	1.17 (0.92, 1.50)	0.200	0.96 (0.71, 1.30)	0.807
Parent education, < High school	1.00	—	1.00	—
High school or GED certificate	1.39 (1.00, 1.93)	0.053	1.67 (1.17, 2.38)	0.005
> High school	1.53 (1.08, 2.17)	0.018	1.71 (1.15, 2.56)	0.009
History of asthma in child	0.95 (0.67, 1.35)	0.767	0.91 (0.62, 1.34)	0.631
History of multiple ear infections in child	1.23 (0.72, 2.09)	0.451	1.30 (0.75, 2.26)	0.356

* Multivariate logistic regression with each factor included in model.

GED = General Educational Development; OR = odds ratio.

Table 3. Secondhand Smoke Exposure Related to Child Surgery and Emergency Department Visits

—	OR (95% CI)	*P* Value	Adjusted OR*	*P* Value
Surgery in the past 12 months				
SHS exposure	1.18 (0.86, 1.60)	0.306	1.12 (0.80, 1.56)	0.525
ED visit in the past 12 months				
SHS exposure	1.59 (1.34, 1.88)	<0.001	1.45 (1.20, 1.74)	<0.001

* Adjusted for sex of child, child age, race of child, family income, and parent education.
ED = emergency department; OR = odds ratio; SHS = secondhand smoke.

ple, the 2005 Social Climate Survey‡ reported that smoking was not allowed in 83.8% (95% CI: 80.3%, 87.3%) of households with children, implying that smoking was permitted in approximately 16%. In a study analyzing National Health and Nutrition Examination Survey data from 2003 to 2006, the prevalence of reported SHS exposure in the home was 17.8% among children 3–19 yr.[4] In another study analyzing the 2007 National Survey of Children's Health, 7.6% of children 0–17 yr were exposed to SHS at home.[3] A comparison of the number of respondents with children who were current smokers and the number of households that permitted smoking indoors suggests that some households use the SHS mitigation strategy of not allowing smoking in the home, although this appears to be a minority of households with smokers.

The concept of a "teachable moment" recognizes that certain life events may motivate behavioral change, and evidence suggests that undergoing surgery is a teachable moment for smoking cessation.[17] In our previous analysis of a nationally representative sample of older adults, undergoing major surgery was associated with an approximately twofold increase in the incidence of quitting smoking in multivariate analysis.[11] The current analysis, which included younger subjects in a different data set, is consistent with this previous finding, showing that parents having surgery within the previous 12 months was associated with more quit attempts, more successful attempts, and a greater intent to quit among those still smoking. The mechanism that underlies this association is not known. McBride *et al.* proposed a theoretical framework for the teachable moment concept, postulating that such events increase perceptions of risk and negative outcome expectancies related to smoking, prompt strong affective or emotional responses, and redefine self-concept or social role.[17] Changes in these constructs motivate an individual to change behavior. This framework has not been tested in the context of smoking behaviors.

The current findings suggest that having a child undergo surgery can serve as a teachable moment for quit attempts but not for successfully quitting. The adjusted odds ratios for quit attempts associated with child and parent surgery were similar, as were those for the intent to quit (table 2), but the ratios for success were quite different. We can only speculate about why surgery was a significant factor associated with sustained abstinence when experienced by the smoker but not the smoker's child. Related to the McBride framework, the perceived link between smoking and risk may be better recognized for personal smoking than for SHS exposure, or emotional responses may be more pronounced when personally contemplating surgery. Whatever the relevant constructs, changes prompted by surgery experienced by one's child may be sufficient to motivate a quit attempt, which are relatively common among smokers (approximately one half of this sample had made an attempt within the past year), but insufficient to overcome the significant barriers to maintaining sustained abstinence, recognizing that there may be unique barriers around the time of a child's surgery. Indeed, parents tended to be even less likely to succeed in quitting if their child had surgery, perhaps reflecting the significant stresses presented by child surgery and the perceived ability of smoking to relieve stress. In the general adult population, recent evidence suggests that motivation to quit smoking predicts cessation attempts but not necessarily the maintenance of smoking cessation.[18,19] Our results provide another example that the determinants of quit attempts differ from those that determine cessation maintenance.

In adults, the diagnosis of medical illnesses can also serve as a teachable moment for smoking cessation.[11,20] However, we find no evidence here that asthma or frequent ear infections in children are associated with changes in the smoking behavior of parents, again perhaps suggesting that personal illness is a more powerful motivator of behavioral change than a child's illness or that any behavior change prompted by the diagnoses of the illnesses predated the time of the survey.

Secondhand smoke exposure increases the risks of anesthesia in children for respiratory complications.[5–9] Adult cigarette smokers are at risk for cardiac and wound-related complications[10]; whether SHS increases children's risk for these complications is not known. The current study provides the first estimate of the proportion of children undergoing surgery in the United States who are exposed to SHS, suggesting that approximately one in seven children undergoing surgery is at increased risk from this source. We had also speculated that SHS itself would increase the risk of undergoing surgery because of an increase in the frequency of conditions such as frequent ear infections that are indications for surgery. Although the rate of surgery was higher among children exposed to SHS, the association was not statistically significant. This may reflect limited statistical power to detect a small odds ratio, or that many surgical indications are not related to SHS (the data set does not have information regarding the type of surgery received). We

‡ American Academy of Pediatrics Julius B. Richmond Center of Excellence. 2008 National Social Climate Survey of Tobacco Control. Data search tool provided by the Child and Adolescent Health Measurement Initiative, Data Resource Center. Available at: http://www.socialclimate.org. Accessed June 30, 2010.

did confirm previous reports that children with SHS used the emergency department more frequently,[21] suggesting that this study had sufficient power to detect some forms of increased healthcare utilization.

This study has several limitations. First, information on smoking behavior and health events were self-reported by parents. Although assessments of SHS exposure in children and self-reported smoking status generally are reliable,[22,23] reporting bias on the basis of social desirability or other factors cannot be excluded, and no biochemical confirmation of exposure is available in these data. Second, it can only be known that surgical events happened in the year before the interview; the exact date of surgery was not known. Thus, the exact temporal relationship between events such as surgery and changes in smoking behavior within the 12 months before the survey cannot be determined, and causality should not be inferred. Third, evidence of SHS exposure outside the home in environments such as automobiles and day-care facilities was not sought, so the actual rate of SHS exposure may be underestimated. Finally, for households with multiple children, the characteristics of these other children (for example, the occurrence of surgery in these children) were not determined and also may have affected parental behavior.

Conclusion

Approximately one in seven children undergoing surgery in the United States is chronically exposed to SHS. Among parents who smoke cigarettes, there is an association between children undergoing surgery and quit attempts but no association with maintaining abstinence. This suggests that the scheduling of children for surgery may present an opportunity to provide tobacco interventions to parents, who apparently are more motivated to at least attempt abstinence but need assistance to succeed. Although efforts to provide tobacco interventions in child healthcare settings have proved challenging,[24] parental smoking cessation is the most effective way to eliminate children's exposure to SHS, which not only potentially benefits children's perioperative outcomes, but also promotes the long-term health of children and their families.

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