ORIGINAL ARTICLES

Environmental tobacco smoke exposure and health effects in children: results from the 1991 National Health Interview Survey

David M Mannino, Michael Siegel, Corinne Husten, Deborah Rose, Ruth Etzel

Abstract

***Objective* – To determine the effect of environmental tobacco smoke exposure on the health of children in the United States.**

***Design and Setting* – Cross-sectional study of children who participated in the 1991 National Health Interview Survey.**

***Participants* – 17448 children residing in the United States.**

***Main Outcome Measures* – Rates of respiratory illnesses and all illnesses, and the morbidity due to these illnesses, in children exposed to environmental tobacco smoke in the home daily compared with those in children not exposed in the home. Our analyses controlled for age, socioeconomic status, race, family size, sex, season, and region of the country.**

***Results* – Children who were exposed to environmental tobacco smoke had a higher incidence of acute respiratory illnesses (relative risk (RR) = 1.10, 95% confidence interval (CI) 0.95 to 1.26) and all chronic respiratory diseases (RR = 1.28, 95% CI 0.99 to 1.65) than children who were not exposed, although both CIs included unity, and chance cannot be ruled out as being responsible for these findings. Children who were exposed to environmental tobacco smoke had, on average, 1.87 more days of restricted activity (95% CI 0.20 to 3.54), 1.06 more days of bed confinement (95% CI 0.20 to 1.92), and 1.45 more days of school absence (95% CI 0.40 to 2.50) per year than children who were not exposed.**

***Conclusions* – Environmental tobacco smoke exposure in the home, which is completely preventable, is an important predictor of increased morbidity in children.**

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Introduction

Environmental tobacco smoke (ETS) contains the same constituents that are known to cause respiratory disease in people who smoke.[1] Many studies have demonstrated an association between ETS exposure and respiratory disease in children.[2–5]

In this study, we used data from the 1991 National Health Interview Survey (NHIS) to investigate the relationship between ETS exposure and morbidity in children. The NHIS was conducted among a probability sample of the civilian, non-institutionalised population of the United States.[6] It consists of an extensive questionnaire that asks participants about their present health status, including whether they have had any recent illnesses or admissions to hospital. In 1991, all participants were asked questions about ETS in their homes. These questions had not been asked in prior surveys but have been asked in the 1992, 1993 and 1994 NHISs. In this study we determined the number of children exposed to ETS in their homes and calculated the incidence and prevalence of respiratory diseases and number of annual days of restricted activity, bed confinement, and school absence experienced by these children and compared these with the corresponding figures for children not exposed to ETS in their homes.

Methods

We searched the 1991 NHIS database for all subjects aged 10 years or younger. We chose this cut-off because, although we did not have personal smoking data on these children, we knew from other research[7] that regular smoking in this age group is rare (less than 1%). In the NHIS, an adult, usually a parent, responds for children under the age of 14. A person from each household was asked, "Does anyone smoke cigarettes, cigars, or pipes anywhere inside this home?" and "On the average, about how many days per week is there smoking anywhere inside this home?" We excluded subjects who did not respond to questions on ETS exposure in their home. For most analyses we compared children who had no in-home ETS exposure with those who had a daily in-home ETS exposure. Because we did not have data on prenatal maternal smoking or birth weight, which are predictors of respiratory disease in the first year of life,[8,9] we excluded children younger than one year old from our analyses.

Respondents were asked about both acute illnesses and acute exacerbations of chronic illnesses experienced by each child during the two weeks preceding the survey. We searched for the following acute respiratory illnesses: common cold, other acute upper respiratory illnesses, influenza, acute bronchitis, and pneumonia.

Chronic diseases could be reported in two ways: in response to a chronic disease questionnaire or as an acute exacerbation of a chronic disease. The total sample was divided into six subgroups, each of which was asked about a different group of chronic illnesses. The chronic illnesses we were interested in were asthma, persistent bronchitis, chronic sinusitis, chronic disease of tonsils and adenoids, and chronic laryngitis. In this survey "chronic" diseases are defined either as two or more episodes of the disease in question or as one episode that lasted for at least one month occurring during the year before the survey. To determine the acute exacerbations of chronic respiratory diseases in the two weeks preceding the survey, we limited the group to the approximate five-sixths of the sample that was not asked about chronic respiratory diseases. To determine the prevalence of these chronic diseases, we limited the total group to the approximate a sixth of the sample that was asked about chronic respiratory diseases.

For each illness listed, the parent was asked how many days the child had restricted activity, was confined to bed, or was absent from school because of this illness in the two weeks before the survey. We limited our analysis of days children were absent from school to children aged 6 years and older. We determined the number of days of restricted activity, bed confinement, and school absence for the entire study group for acute respiratory illnesses, all acute illnesses, exacerbations of chronic respiratory diseases, and all chronic diseases. We multiplied the number of days by 26 to obtain annual estimates. We classified each child as having one or more versus no days of restricted activity, bed confinement, or school absence in the two weeks before the survey for use in logistic regression models.

Confounders which we controlled for in our analyses included socioeconomic status, sex, family size, region of country, race, season during which the questionnaire was completed, and age. We classified children as lower socioeconomic status if they were from a family in which either the total family income was below the 1990 poverty level (derived from the August 1991 Current Population Survey[10] and calculated on the basis of family size, number of children less than 18 years old, and family income) or the responding adult family member had a 12th grade education or less. We excluded children for whom data on poverty status or the educational level of the responsible adult were missing. We used the NHIS weights in all of our regression analyses, along with our determination of national population estimates.

We estimated the relative risk for disease and for days of restricted activity, bed confinement, and school absence among children exposed to ETS; by applying these relative risk estimates to the estimated number of exposed children in the United States we then estimated the amount of morbidity among American children that is attributable to ETS exposure.

Because the NHIS is a complex sample design, we used SUDAAN (RTI, Research Triangle Park, North Carolina) to determine variances and to do significance testing.[11] The point estimates obtained using SUDAAN are identical to those obtained using SAS (SAS Institute, Cary, North Carolina), whereas the variances are larger with SUDAAN because the complex sample design is considered. We used the SUDAAN procedures RLOGIST (logistic regression), REGRESS (linear regression), CROSSTAB, and DESCRIPT in these analyses. In the logistic and linear regressions we included socioeconomic status, sex, family size, region of country, race, season during which the questionnaire was completed, and age as potential confounders and effect modifiers.

Results

We analysed data on 17448 children who were 1–10 years old. These subjects represent an estimated 33.7 million children in that age range in the United States in 1991. On the basis of these data, we estimate that 10.5 million children (31.2%) were exposed to ETS in their homes daily, while 12.5 million children (37.0%) were exposed to ETS in their homes daily, or less than daily.

The rate of ETS exposure in the home varied by socioeconomic status. Socioeconomic status was unavailable on 1333 subjects, representing an estimated 2542000 children nationally. Among children of lower socioeconomic status, 41.1% had daily ETS exposure in their home, whereas only 20.7% of the children of higher socioeconomic status had such daily ETS exposure (table 1). ETS exposure also varied by age and region, but not by race, family size, sex, or season (table 2).

We compared data from 9632 children with no ETS exposure in the home (representing an estimated 18.8 million children nationally) with data from 5047 children with daily ETS exposure in the home (representing an estimated 9.6 million children nationally). In the two weeks before the survey, children who were exposed to ETS in the home had a greater incidence of respiratory illness (7.9% *vs* 6.8%, $p = 0.07$) and chronic respiratory disease exacerbations (2.5% *vs* 2.3%, $p = 0.45$) than children who were not exposed, although chance can not be excluded as a reason for these findings. Children who were exposed to ETS had a higher prevalence of chronic respiratory disease (18.0% *vs* 15.7%, $p = 0.19$) than children who were not exposed, but again, chance can not be excluded as a reason for these findings. After controlling for age, sex, family size, SES, season, and region of the country (using logistic regression), children who were exposed to ETS in the home had a higher incidence of respiratory illnesses (relative risk (RR) = 1.10, 95% confidence interval (CI) = 0.95 to 1.26) than children who were not exposed and a higher prevalence of chronic respiratory diseases (RR = 1.28, 95% CI 0.99 to 1.67), although the confidence intervals were wide and included unity. Children exposed to ETS in the home had a similar prevalence of chronic respiratory disease ex-

Table 1 Study population of children, age 1–10 years, stratified by socioeconomic status and environmental tobacco smoke (ETS) exposure, from the 1991 National Health Interview Survey (NHIS). The national estimates of these populations were determined using NHIS weights

ETS exposure at home	Lower socioeconomic status*		Higher socioeconomic status	
	n	Estimated national population	n	Estimated national population
Unknown	261	510000	210	428000
None	3896	7447000	5736	11315000
Less than daily	615	1168000	350	708000
Daily	3379	6372000	1668	3244000
Total	8181	15497000	7964	15695000

* Socioeconomic status was classified as "lower" if either the total family was below the poverty level or the responding adult family member had a 12th grade education or less. Socioeconomic status was unavailable on 1333 subjects representing an estimated 2542000 children nationally.

Table 2 Study population of children, age 1–10 years, stratified by socioeconomic status, race, family size, region of country, season, and age, with the number and weighted percentage of children in each category (by row) exposed and not exposed to environmental tobacco smoke (ETS), from the 1991 National Health Interview Survey

		Daily exposure		No exposure		
		n	Weighted %	n	Weighted %	p*
Socioeconomic status	Lower	3379	46.5	3896	53.5	< 0.01
	Higher	1668	22.5	5736	77.5	
Race	White	3807	33.8	7450	66.2	0.80
	Non-white	1240	34.2	2182	65.8	
Family size	⩽ 5	4094	33.7	7951	66.3	0.51
	⩾ 6	953	34.8	1681	65.2	
Sex	Female	2481	34.2	4981	65.8	0.41
	Male	2566	33.6	4651	66.4	
Region	Northeast	978	33.6	1883	66.4	< 0.01
	Midwest	1449	39.2	2208	60.8	
	South	1729	37.4	2875	62.6	
	West	891	24.3	2660	75.7	
Season	Winter	1296	34.8	2348	65.2	0.47
	Spring	1436	32.8	2869	67.2	
	Summer	1474	34.7	2752	65.3	
	Autumn	841	32.8	1663	67.2	
Age (years)	1	486	32.7	996	67.3	0.01
	2	505	32.9	1039	67.1	
	3	487	32.7	984	67.3	
	4	484	33.2	948	66.8	
	5	476	31.0	1027	69.0	
	6	517	33.6	1001	66.4	
	7	487	35.4	877	64.6	
	8	574	38.3	900	61.7	
	9	499	34.5	920	65.5	
	10	532	35.0	940	65.0	
Total		5047	33.9	9632	66.1	

* Significance determined using χ^2 or analysis of variance.

acerbations (RR = 1.04, 95% CI 0.80 to 1.36) as children who were not exposed.

Children who were exposed to ETS had 21% more days of restricted activity (10.5 *vs* 8.7, p = 0.01), 31% more days of bed confinement (4.2 *vs* 3.2, p = 0.01), and 39% more days of school absence (5.7 *vs* 4.1, p = 0.01) than children who were not exposed (tables 3 and 4). The mean number of annual days of restricted activity, bed confinement, and school absence also varied significantly by season, but not by race, family size, sex, region of the country or age (tables 3 and 4). After adjusting for these confounding variables (using linear regression), children who were exposed to ETS had, on average, 1.87 (21%) more days of restricted activity, 1.06 (33%) more days of bed confinement, and 1.45 (35%) more days of school absence, annually, than children who were not exposed (table 5). Acute and chronic respiratory diseases among children exposed to ETS accounted for 95% of the increase in days of restricted activity, 47% of the increase in days of bed confinement, and 59% of the increase in days of school absence. We estimate that, nationally, children exposed to ETS daily have 17.9 million days of restricted activity, 10.1 million days of bed confinement, and 7.1 million days of school absence attributable to ETS exposure (figure). In a separate analysis, using logistic regression, we determined that children exposed to ETS daily in the home were more likely to have one or more days of restricted activity (RR = 1.26, 95% CI 1.09 to 1.45), one or more days of bed confinement (RR = 1.25, 95% CI 1.04 to 1.49), and one or more days of school absence in the two weeks before the survey (RR = 1.36, 95% CI 1.12 to 1.66) than children who were not exposed.

Discussion

In this study, we found that children exposed to ETS at home had more annual days of restricted activity, bed confinement, and school absence than did children not exposed to ETS at home. These findings remained significant after we adjusted for age, socioeconomic status, race, family size, sex, season, and region of the country. Our results also suggested a higher incidence of acute respiratory illnesses and a higher prevalence of chronic respiratory diseases in children exposed to ETS, although chance could not be ruled out based on the confidence intervals.

In our study, 37.0% of the children were exposed to ETS at home according to their parents' reports. In 3.7% of the sample, we did not have data on ETS exposure in the home, so the true exposure prevalence may be slightly higher. Results of a study that examined data from the 1970 NHIS showed that 62% of children were presumably exposed to ETS in the home, on the basis of at least one adult in their household reporting smoking.[12] Results of a later study, which analysed data from the 1988 NHIS, showed that 42.4% of children were exposed to ETS in the home.[13] The declining rate of in-home ETS exposure among American children can be partially explained by a corresponding decline in the prevalence of smoking in the adult population of the United States from 40.7% in 1970 to 25.7% in 1991.[14]

Previous researchers have examined the relationship between ETS exposure and health effects among children in the NHIS.[12,15] Results of one study that used data from the 1970 NHIS showed that children in families with two smoking parents had, on average, 1.1 more restricted activity days and 0.8 more bed confinement days per year than children without smoking parents.[12] That study also determined that acute respiratory illnesses accounted for this increased morbidity among children exposed to ETS. Results of another study, which analysed NHIS data from 1976 through 1980, showed that children exposed to ETS, on the basis of reported parental smoking, had 20% more bed confinement days than children not exposed.[15]

Table 3 Study population of children, age 1–10 years, stratified by environmental tobacco smoke (ETS) exposure, socioeconomic status, race, family size, region of country, season, and age, by mean (SE) number of annual days of reported restricted activity and bed confinement. From the 1991 National Health Interview Survey

			Restricted activity (days)			Bed confinement (days)		
		n	Mean	(SE)	p*	Mean	(SE)	p
ETS exposure at home	Daily	5047	10.5	(0.7)	0.01	4.2	(0.4)	0.01
	None	9632	8.7	(0.5)		3.2	(0.2)	
Socioeconomic status	Higher	7275	9.5	(0.6)	0.58	3.4	(0.2)	0.13
	Lower	7404	9.1	(0.5)		3.7	(0.3)	
Race	White	11257	9.7	(0.5)	0.06	3.5	(0.2)	0.39
	Non-white	3422	7.8	(0.7)		3.7	(0.4)	
Family size	5	12045	9.6	(0.4)	0.05	3.5	(0.2)	0.73
	⩾ 6	2634	8.0	(0.9)		3.8	(0.5)	
Sex	Female	7132	9.1	(0.5)	0.29	3.7	(0.2)	0.49
	Male	7547	9.4	(0.5)		3.4	(0.2)	
Region	Northeast	2861	7.7	(0.8)	0.13	3.4	(0.4)	0.94
	Midwest	3657	9.7	(0.8)		3.5	(0.3)	
	South	4604	9.2	(0.7)		3.6	(0.4)	
	West	3557	10.3	(0.9)		3.7	(0.4)	
Season	Winter	3644	13.4	(0.9)	< 0.01	5.1	(0.4)	< 0.01
	Spring	4305	7.2	(0.6)		2.3	(0.2)	
	Summer	4226	5.2	(0.5)		2.0	(0.2)	
	Autumn	2504	12.9	(1.1)		5.8	(0.6)	
Age (years)	1	1482	12.1	(1.2)	< 0.02	4.6	(0.7)	0.14
	2	1544	9.1	(1.0)		2.7	(0.4)	
	3	1471	9.1	(1.0)		3.2	(0.5)	
	4	1432	8.3	(1.0)		3.7	(0.6)	
	5	1503	10.8	(1.1)		4.1	(0.6)	
	6	1518	7.7	(0.8)		3.1	(0.4)	
	7	1364	9.7	(1.3)		3.4	(0.5)	
	8	1474	8.3	(0.9)		3.0	(0.3)	
	9	1419	9.2	(1.5)		4.0	(0.6)	
	10	1472	8.8	(1.0)		3.8	(0.5)	
Total		14679	9.3	(0.4)		3.6	(0.2)	

* Significance testing determined using χ^2 or analysis of variance.

Table 4 Study population of children, age 6–10 years old, stratified by environmental tobacco smoke (ETS) exposure, socioeconomic status, race, family size, region of country, season, and age, by mean (SE) number of annual days of reported school absence. From the 1991 National Health Interview Survey

			School absence (days)		
		n	Mean	(SE)	p*
ETS exposure at home	Daily	2609	5.7	(0.5)	0.01
	None	4638	4.1	(0.3)	
Socioeconomic status	Higher	3663	4.5	(0.3)	0.20
	Lower	3584	5.0	(0.4)	
Race	White	5649	4.8	(0.3)	0.58
	Non-white	1598	3.9	(0.5)	
Family size	⩽ 5	5850	4.9	(0.3)	0.14
	⩾ 6	1397	3.9	(0.5)	
Sex	Female	3488	4.7	(0.3)	0.71
	Male	3759	4.7	(0.3)	
Region	Northeast	1401	4.9	(0.6)	0.95
	Midwest	1891	5.2	(0.4)	
	South	2289	4.5	(0.4)	
	West	1666	4.3	(0.6)	
Season	Winter	1765	8.2	(0.6)	< 0.01
	Spring	2108	3.5	(0.4)	
	Summer	2127	1.3	(0.3)	
	Autumn	1247	6.8	(0.7)	
Age (years)	6	1518	4.2	(0.5)	0.14
	7	1364	4.9	(0.6)	
	8	1474	5.0	(0.6)	
	9	1419	5.0	(0.6)	
	10	1472	4.4	(0.5)	
Total		7247	4.7	(0.3)	

* Significance testing determined using χ^2 or analysis of variance.

We detected 35% more days of school absence among children exposed to ETS in their home than among children not exposed, after adjusting for confounders. This finding is similar to that from a study of 2885 children aged 12 and 13 years, where the odds ratio for school absence was 1.39 (95% CI 1.15 to 1.67) among children who were exposed to ETS in the home, compared with children who were not.[16] We also determined that children exposed to ETS were more likely to have missed one or more days of school in the two weeks before the survey (RR = 1.36, 95% CI 1.12 to 1.66).

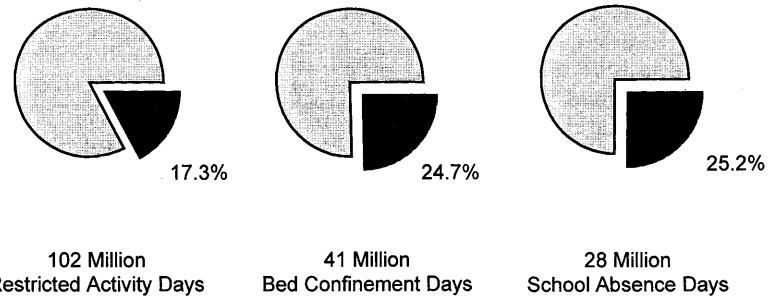
In various studies, ETS exposure in children has been linked to several diseases, including asthma,[4,5] lower respiratory infections,[17] and middle ear disease.[18] A 1993 Environmental Protection Agency (EPA) report based on results from these and other studies indicated that American children 18 months old and younger who are exposed to ETS have, annually, 150000–300000 (100000–200000 per year of life) more lower respiratory infections, including pneumonia, bronchitis, and bronchiolitis.[1] The EPA also estimates that ETS exposure causes an additional 7500–15000 admissions to hospital for asthma, 200000–1 million asthma attacks, and 8000–26000 cases of new asthma among American children. Data from our study suggest that American children aged 1–10 years exposed to ETS in the home had 10% more respiratory illnesses than children not exposed, although the confidence intervals were wide and included unity. Among the 9.6 million children exposed to ETS in the home daily, this increase in respiratory illnesses represents an additional 1.7 million cases annually (confidence intervals ranging from 0.9 million fewer cases to 4.4 million additional cases), or 170000 per year of life, which is similar to the EPA estimate.

Our study also suggested an increase in the prevalence of chronic respiratory diseases among children exposed to ETS, although again, the confidence intervals included unity. Our RR of 1.28 (95% CI 0.99, 1.67) is similar

Table 5 The increased number of days annually of restricted activity, bed confinement, and school absence among children exposed to environmental tobacco smoke (ETS), after adjusting for age, socioeconomic status, race, family size, sex, season, and region of country. From the 1991 National Health Interview Survey

	Days annually	95% CI
Days of restricted activity		
Acute respiratory illnesses	1.35	(0.18, 1.71)
All chronic respiratory diseases*	0.42	(0.09, 0.75)
All illnesses	1.87	(0.20, 3.54)
Days of bed confinement		
Acute respiratory illnesses	0.31	(−0.09, 0.70)
All chronic respiratory diseases	0.18	(0.02, 0.34)
All illnesses	1.06	(0.20, 1.92)
Days of school absence (age ⩾ 6 years)		
Acute respiratory illnesses	0.87	(0.19, 1.55)
All chronic respiratory diseases	−0.02	(−0.18, 0.14)
All illnesses	1.45	(0.40, 2.50)

* Chronic respiratory diseases are asthma, persistent bronchitis, chronic sinusitis, chronic disease of tonsils and adenoids, and chronic laryngitis.
CI = confidence interval.



Left and centre: the black segments represent the increased number of days of restricted activity and bed confinement attributable to environmental tobacco smoke (ETS) exposure among an estimated 9.6 million children in the United States (ages 1–10 years) exposed daily to ETS in their homes. Right: the black segment represents the increased number of days of school absence attributable to ETS exposure among an estimated 4.9 children (ages 6–10 years) exposed to ETS daily in their homes.

to the results of another national study that found that children exposed to ETS had a higher risk of wheezing and lower respiratory illnesses (RR = 1.36, 95% CI 1.14 to 1.62).[19] We did not detect an increase in reported exacerbations of asthma and chronic respiratory diseases among children exposed to ETS. This finding, along with a possible underestimate of the effect of ETS exposure on the prevalence of asthma and chronic respiratory diseases, may be related to changes in parental smoking behaviour. Other researchers have shown that parents of children who have developed a respiratory disease may decrease or eliminate smoking around the children.[20,21] Our survey asked only about current smoking in the home, with no questions asked about prior smoking or changes in smoking behaviour. Additionally, we did not have data available to determine the incidence of chronic respiratory disease or the number of admissions to hospital for respiratory disease.

Our study has several limitations. The main limitation was related to sample size. The results we obtained evaluating the increased incidence of acute respiratory disease and the prevalence of chronic respiratory disease among children exposed to ETS included unity in the 95% CI. Even though the sample that we used in the analysis included almost 15000 children, the power of this study to detect a 10% increase (from 7.0% to 7.7%) in the two-week incidence of acute respiratory illnesses was only 0.30. The study would have had to include over 55000 children to have a power of 0.80. Similarly, our study had 2457 children who were asked about the prevalence of chronic respiratory disease, and had a power of 0.60 to detect a 25% increase in the prevalence of chronic respiratory disease (from 14.0% to 17.5%). This sample would have had to include almost 4000 children to have a power of 0.80.

Neither our study nor any of the previous studies that analysed the relationship between ETS exposure and days of restricted activity, bed confinement, or school absence validated reported ETS exposure with an objective measurement, such as urinary cotinine. Results of a prior study that used urinary cotinine measurements to validate reported ETS exposures showed that children from families with two smoking parents had higher urinary cotinine levels than those from families with no smoking parents.[22] In this prior study, however, some children whose parents did not smoke had urinary cotinine levels greater than 100 ng/mg creatinine, suggesting that they had ETS exposure from someone other than their parents, that the parents did not accurately report ETS exposure, or that the children were smoking. We compared children with no reported ETS exposure at home to those with daily ETS exposure at home. Because our study lacked any such objective measurement of children's overall exposure to tobacco smoke, children with no reported ETS exposure at home who were exposed to ETS outside their home would thus bias our results toward not finding an effect of ETS on respiratory health.

Another limitation in our study is that we do not have data on the amount of ETS to which a child was exposed. Results of two studies have shown that children exposed to more ETS ("more" being defined on the basis of the number of cigarettes smoked in the household daily) have more respiratory illnesses than children exposed to less ETS.[23,24] In our analysis, however, a child exposed to the smoke from one cigarette per day would be in the same exposure category as a child exposed to the smoke from 40 cigarettes daily. This limitation would also bias our results toward not finding an effect of ETS on respiratory health. Although we did have data on a small number of children with less than daily ETS exposure (with no information on how much ETS the children were exposed on days they were exposed), inclusion of these children in the analysis produced results with very wide confidence intervals.

A fourth limitation of our study is that we could not validate the presence of reported diseases or the accuracy of the diagnoses. This could be especially problematic in diseases such as asthma, which could also be diagnosed as bronchitis or reactive airways disease. Many other diseases, such as ear infections or lower respiratory diseases, may have been misdiagnosed by the reporting person. This misreporting could bias our results either toward or away from finding an effect of ETS on the prevalence of respiratory disease. We

would not expect this misreporting, however, to affect the reported total number of days of restricted activity, bed confinement, or school absence, which would be independent of the diagnosis.

A fifth limitation of our study is that we were not able to include children younger than 1 year old or older than 10 years old in this study. We excluded infants because we did not have information on birth weight or prenatal smoke exposure, and some our findings in younger children may be related to these factors. We know from other studies that virtually all children who had mothers who smoked during the pregnancy were exposed to ETS as a child, whereas approximately 50 % of children exposed to ETS as a child were exposed *in utero*.[13]

We conclude that ETS exposure is a predictor of morbidity in children. In addition, we determined that children exposed to ETS are likely to be absent from school, confined to bed, or have restricted activity more often than children not exposed. A portion of children's respiratory diseases and their associated morbidity can be prevented by decreasing or eliminating children's exposure to ETS.

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