

Environmental Tobacco Smoke: Public Perception of Risks of Exposing Children to Second- and Third-Hand Tobacco Smoke

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ABSTRACT

Introduction: Extensive evidence exists regarding health risks posed by children's exposure to second-hand smoke, and there is increasing evidence concerning the risks of third-hand smoke. This evidence is most meaningful if the public is aware of these risks and can help curb childhood exposure.

Methods: Participants were selected at an academic medical center and asked to complete a survey. Responses were compared based on respondents' smoking status and the presence or absence of children in their homes.

Results: A total of 310 adults responded. Nonsmokers and respondents living with children were more likely to see smoking in the home as affecting all the queried health problems ($p < .05$). Knowledge of the risks of second-hand smoke exposure is limited, and very few respondents perceived risk from third-hand smoke exposure.

Discussion: The widespread lack of awareness of the risks associated with environmental tobacco smoke must be addressed to curb childhood exposure. *J Pediatr Health Care.* (2016) ■, ■-■.

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KEY WORDS

Environmental tobacco smoke, pediatrics, secondhand smoke, third-hand smoke, tobacco control, public health

INTRODUCTION

There is an abundance of evidence describing the impact that environmental tobacco smoke (ETS) can have on children's health. Many of the harmful effects of ETS include respiratory symptoms, such as increasing the incidence of coughing, asthma, and both upper and lower respiratory tract infections (American Academy of Pediatrics Committee on Substance Abuse, 1994; American Academy of Pediatrics Committee on Environmental Health, 1997; Cook & Strachan, 1999; U.S. Department of Health and Human Services, 2014; Johansson, Halling, & Hermansson, 2003; Li, Peat, Xuan, & Berry, 1999), as well as increasing the severity of childhood pneumonia (Ahn et al., 2015). Exposure

to ETS can also lead to numerous disorders of the ear, nose, and throat such as otitis media (Adair-Bischoff & Sauve, 1998; U.S. Department of Health and Human Services, 2014; Ilicali, Keles, Deger, & Savas, 1999; Jones, Hassanien, Cook, Britton, & Leonardi-Bee, 2012), sensorineural hearing loss (Lalwani, Liu, & Weitzman, 2011; Talaat, Metwaly, Khafagy, & Abdelraouf, 2014), and tonsillitis (Straight, Patel, Lehman, & Carr, 2015). ETS exposure increases the incidence of childhood obesity (Apfelbacher et al., 2008; Mangrio, Lindstrom, & Rosvall, 2010; Moore et al., 2016; Raum et al., 2011), and it can also lead to poor childhood growth as measured by height (Muraro et al., 2014). ETS exposure can also increase the incidence of sleep-disordered breathing (Jara, Benke, Lin, & Ishman, 2015). This

is not meant to be a comprehensive list of the risks of ETS exposure; rather, it is meant to give a sense of the extensive health consequences associated with ETS exposure.

Although there is a large body of evidence substantiating the harmful effects of ETS on children's health, this evidence would have a greater impact if the public were aware of these risks.

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Previous studies have shown that awareness of the risks of ETS exposure can lead to the implementation of smoking bans in cars and homes (Drehmer et al., 2014; Winickoff et al., 2009).

The present study was designed to evaluate the general population's risk perception of the dangers that ETS exposure poses to children, including an analysis of the risk perceptions for exposure to both second-hand tobacco smoke (SHS), which is exposure to smoke because of proximity to a person who is actively smoking, and third-hand tobacco smoke (THS), which is exposure to compounds that remain in the air and on surfaces such as furniture and clothing after someone has finished smoking rather than exposure to the smoke itself. This study was also designed to assess how these risk perceptions differ between cohorts based on present and past smoking habits and the presence or absence of individuals under the age of 18 years living in respondents' homes.

METHODS

After approval by the institutional review board, data were collected through the use of written surveys, which were randomly distributed to adults in an otolar-

ingology-head and surgery clinic at an academic medical center. These surveys were distributed between June 11, 2012, and August 6, 2012. Potential participants were approached in the clinic by a member of the research team and offered a survey to complete while they waited. The participants included patients, parents of patients, and accompanying family members or friends who were at least 18 years of age. Only one respondent per family group was solicited. Because of lack of foreign language interpreters, participants were required to be able to communicate using either spoken or written English to complete the surveys, and the surveys were administered verbally upon request.

The survey questions were presented in a scenario format to represent situations of both SHS and THS exposures (the survey questions are available as supplementary material at <http://dx.doi.org/10.1016/j.pedhc.2016.08.008>). Participants were asked whether they believed that these ETS exposures could be related to the progression of asthma, poor growth, obesity, frequent colds, pneumonia, ear infections, hearing loss, tonsillitis, and snoring in exposed children. These scenarios included the following:

- A person habitually smokes in the same room/car as a child. Could this person's smoking be related to the following in the child? (asthma, poor growth, obesity, frequent colds, pneumonia, ear infections, hearing loss, tonsillitis, and snoring)
- A person habitually smokes in a DIFFERENT room in the same home as a child. Could this person's smoking be related to the following in the child? (asthma, poor growth, obesity, frequent colds, pneumonia, ear infections, hearing loss, tonsillitis, and snoring)
- A person habitually smokes OUTSIDE the home where this person and a child live. Could this person's smoking be related to the following in the child? (asthma, poor growth, obesity, frequent colds, pneumonia, ear infections, hearing loss, tonsillitis, and snoring)

Respondents were able to answer *yes*, *no*, or *don't know* for each of these questions. Respondents were asked to evaluate the association between ETS exposure and each of these conditions individually as opposed to grouping the conditions for each scenario (e.g., respondents could answer that asthma and frequent colds were related to the smoke exposure in one of the ETS exposure scenarios but also answer that obesity and ear infections were not related to the ETS exposure in that particular scenario).

There were also questions to assess participants' current and past smoking habits, risk perception of the effects of firsthand tobacco smoke on the smoker's health, and the presence or absence of individuals under the age of 18 years living in their homes. There were no identifiers on the questionnaire, so there was no tracking of who had completed the survey. Individuals were not compensated for their participation in this study.

Statistical Analysis

The data collected from these surveys were analyzed using chi-square tests, with a *p* value of less than .05 representing a significant difference. Participants' responses for each of the individual conditions listed in the scenarios were compared on the basis of whether the respondents were current smokers or nonsmokers, previous smokers, or had never smoked and whether or not they currently lived in a home with a child under the age of 18 years.

RESULTS

A total of 310 surveys were returned with all of the necessary responses provided, and 300 of these included responses to all of the questions listed. Of the 310 respondents who answered all necessary questions, 181 (58.3%) had children living in their homes either full or part time and, 61 (19.7%) reported themselves to be smokers. A total of 304 (98.1%) respondents

answered *yes* when asked whether they thought smoking could be detrimental to the smoker's health.

Overall, more respondents saw an association of ETS exposure with childhood asthma than with any other condition, with 86% of all participants responding that habitually smoking in the same room or car as a child could be related to asthma in the child. The following are other overall results as to whether respondents thought smoking in the same room/car as a child could be related to the given conditions, regardless of the respondents' current/former smoking status or whether they currently live with children in their homes: 72% thought it could be related to frequent colds, 67% to pneumonia, 57% to poor growth, 49% to ear infections, 45% to tonsillitis, 43% to snoring, 27% to hearing loss, and 20% to obesity.

Table 1 displays the comparisons between current smokers and nonsmokers and between previous smokers and respondents who never smoked,

TABLE 1. Comparison of responses based on current and former smoking status

| Condition | Current smokers (n = 61) | Current nonsmokers (n = 249) | Significant difference (p < .05)? | Previous smokers (n = 146) | Respondents who never smoked (n = 164) | Significant difference (p < .05)? |
|---|--------------------------|------------------------------|-----------------------------------|----------------------------|--|-----------------------------------|
| A person habitually smokes in the same room/car as a child. Could this person's smoking be related to the following in the child? | | | | | | |
| Asthma | 79 | 88 | * | 85 | 87 | * |
| Poor growth | 48 | 59 | * | 53 | 61 | * |
| Obesity | 13 | 22 | * | 15 | 25 | * |
| Frequent colds | 57 | 75 | * | 69 | 75 | * |
| Pneumonia | 56 | 70 | * | 65 | 69 | * |
| Ear infections | 43 | 51 | * | 44 | 54 | * |
| Hearing loss | 20 | 29 | * | 22 | 32 | * |
| Tonsillitis | 39 | 47 | * | 41 | 49 | * |
| Snoring | 36 | 45 | * | 38 | 48 | * |
| A person habitually smokes in a DIFFERENT room in the same home as a child. Could this person's smoking be related to the following in the child? | | | | | | |
| Asthma | 75 | 82 | * | 80 | 82 | * |
| Poor growth | 43 | 50 | * | 46 | 51 | * |
| Obesity | 10 | 21 | * | 14 | 24 | * |
| Frequent colds | 49 | 71 | * | 62 | 71 | * |
| Pneumonia | 51 | 65 | * | 60 | 64 | * |
| Ear infections | 39 | 47 | * | 41 | 59 | * |
| Hearing loss | 17 | 24 | * | 17 | 28 | * |
| Tonsillitis | 35 | 45 | * | 29 | 47 | * |
| Snoring | 30 | 40 | * | 34 | 42 | * |
| A person habitually smokes OUTSIDE the home where this person and a child live. Could this person's smoking be related to the following in the child? | | | | | | |
| Asthma | 28 | 45 | * | 34 | 49 | * |
| Poor growth | 15 | 25 | * | 20 | 26 | * |
| Obesity | 8 | 13 | * | 10 | 15 | * |
| Frequent colds | 20 | 36 | * | 16 | 38 | * |
| Pneumonia | 16 | 32 | * | 25 | 32 | * |
| Ear infections | 18 | 25 | * | 18 | 29 | * |
| Hearing loss | 10 | 16 | * | 12 | 16 | * |
| Tonsillitis | 18 | 23 | * | 21 | 23 | * |
| Snoring | 16 | 20 | * | 18 | 21 | * |

Note. Percentage of respondents (rounded to the nearest whole number) who answered yes to the question for each of the listed conditions. The respondents were divided into groups based on whether they were current smokers or current nonsmokers and whether they were previous smokers or had never smoked.
*Significant difference (p < .05) between the two groups based on chi-square analysis.

regarding their responses to each of the three scenarios. The chi-square analyses showed significant differences ($p < .05$) for all nine conditions in each of three scenarios when current smokers were compared with current nonsmokers and when previous smokers were compared with those who had never smoked. In all cases, current nonsmokers and respondents who had never smoked were more likely to perceive negative effects of environmental tobacco smoke on a child's health than current smokers and previous smokers.

Comparisons of the responses acquired from individuals currently living with children either full or part time and respondents with no children in their homes are presented in Table 2. When asked about the potential dangers posed to children by habitually smoking in the same room/car as the children, significant differences ($p < .05$) were shown for all nine conditions

when respondents with children currently living in their homes were compared with respondents without children currently living in their homes. Respondents with children currently living in their homes were more likely to believe that smoking was related to each of the conditions in children exposed to SHS.

When asked how habitually smoking in a different room in the same household as the child could be related to the listed conditions in the child, there was a significant difference ($p < .05$) in the responses of those currently living with children and those with no children in their homes for all of the conditions listed except pneumonia. For the impact on the child's health of habitually smoking outside the home where the smoker and child live, the responses collected from those currently living with children and those with no children in their homes showed significant differences

TABLE 2. Comparison of responses based on presence or absence of children in the respondents' homes

| Condition | Respondents with children at home (n = 181) | | | Respondents without children at home (n = 129) | | | Significant difference (p < .05)? |
|---|---|----|------------|--|----|------------|-----------------------------------|
| | Yes | No | Don't know | Yes | No | Don't know | |
| A person habitually smokes in the same room/car as a child. Could this person's smoking be related to the following in the child? | | | | | | | |
| Asthma | 89 | 8 | 3 | 82 | 4 | 14 | * |
| Poor growth | 64 | 20 | 17 | 48 | 14 | 38 | * |
| Obesity | 23 | 40 | 37 | 16 | 29 | 56 | * |
| Frequent colds | 77 | 11 | 12 | 65 | 10 | 25 | * |
| Pneumonia | 72 | 15 | 13 | 60 | 12 | 29 | * |
| Ear infections | 56 | 20 | 24 | 40 | 18 | 42 | * |
| Hearing loss | 32 | 33 | 36 | 20 | 24 | 56 | * |
| Tonsillitis | 49 | 23 | 28 | 40 | 14 | 46 | * |
| Snoring | 52 | 19 | 29 | 31 | 19 | 50 | * |
| A person habitually smokes in a DIFFERENT room in the same home as a child. Could this person's smoking be related to the following in the child? | | | | | | | |
| Asthma | 86 | 9 | 4 | 74 | 8 | 19 | * |
| Poor growth | 56 | 22 | 22 | 29 | 18 | 43 | * |
| Obesity | 22 | 39 | 38 | 14 | 29 | 57 | * |
| Frequent colds | 72 | 16 | 12 | 59 | 17 | 24 | * |
| Pneumonia | 66 | 18 | 16 | 57 | 17 | 26 | |
| Ear infections | 52 | 25 | 23 | 27 | 22 | 41 | * |
| Hearing loss | 28 | 36 | 36 | 15 | 28 | 57 | * |
| Tonsillitis | 47 | 24 | 29 | 28 | 17 | 45 | * |
| Snoring | 46 | 24 | 20 | 28 | 24 | 48 | * |
| A person habitually smokes OUTSIDE the home where this person and a child live. Could this person's smoking be related to the following in the child? | | | | | | | |
| Asthma | 47 | 36 | 17 | 35 | 35 | 30 | * |
| Poor growth | 27 | 42 | 31 | 17 | 39 | 44 | * |
| Obesity | 14 | 47 | 39 | 10 | 42 | 48 | |
| Frequent colds | 36 | 40 | 24 | 27 | 37 | 36 | |
| Pneumonia | 33 | 40 | 27 | 23 | 30 | 37 | |
| Ear infections | 26 | 42 | 31 | 20 | 36 | 43 | |
| Hearing loss | 17 | 46 | 37 | 11 | 39 | 50 | |
| Tonsillitis | 23 | 42 | 34 | 20 | 37 | 43 | |
| Snoring | 24 | 43 | 33 | 14 | 38 | 48 | * |

Note. Percentage of respondents (rounded to the nearest whole number) who answered yes, no, or don't know to the question for each of the listed conditions. The respondents are divided into groups of those who currently live with children either full or part time and those who do not live with children.

*Significant difference ($p < .05$) between the two groups based on chi-square analysis.

($p < .05$) for only asthma, poor growth, and snoring. Again, in all cases for which significant differences were found, respondents currently living with children were more likely to believe that ETS negatively affects the child's health.

Comparing current smokers who live with children ($n = 39$) with people who live with children but have never smoked ($n = 102$) showed the same trends, with the smokers indicating less frequently that they believed smoking affected the child's health, but the groups were smaller, so there were fewer statistically significant differences ($p < .05$). Within these groups, respondents who had never smoked were more likely ($p < .05$) to understand the relationship between frequent colds in the child when exposed to ETS from any of the three scenarios presented. These respondents who live with children but have never smoked were also more likely ($p < .05$) to respond that ETS exposure could be related to pneumonia and snoring in the child when presented with the second and third ETS exposure scenarios.

DISCUSSION

According to a 2006 Surgeon General Report, nearly 60% of children between the ages of 3 and 11 years and over 40% of nonsmoking adults are exposed to SHS in the United States (U.S. Department of Health and Human Services, 2006). Although there is evidence to suggest that exposure to SHS in the United States declined between 1999 and 2008, it is estimated that 88 million nonsmokers ages 3 years and older were still exposed to SHS from 2007 to 2008 (Centers for Disease Control and Prevention, 2010). Moreover, individuals between the ages of 3 and 19 years remained among the most exposed populations to SHS in every period between 1999 and 2008, and progress in reducing this trend declined throughout this time period (Centers for Disease Control and Prevention, 2010).

The increasing awareness of THS existence has led to the realization that ETS exposure extends beyond the effects of SHS alone. A variety of studies have shown that harmful compounds from THS can be found in dust, surfaces, and air in places such as homes, vehicles and even hospitals (Matt et al., 2004; Matt et al., 2011; Northrup et al., 2015; Sleiman et al., 2010; Thomas et al., 2014). One such study found that compounds from THS can be found in homes up to 2 months after smokers have moved out (Matt et al., 2011). Because compounds present in THS have been shown to cause damage to DNA in human cells (Hang et al., 2013), acknowledging the presence of THS is critical for minimizing the adverse effects of ETS on children.

Several studies have been performed to elucidate how the public perceives the risks that ETS can have on children's health. Data collected in 2005, for instance, showed that 95.4% of nonsmokers and 84.1% of smokers believed that SHS negatively affects children's

health, whereas 65.2% of nonsmokers and 43.3% of smokers believed that THS harms children's health (Winickoff et al., 2009). Although we found a similar divide between smokers and nonsmokers, the percentages of respondents who believe SHS and THS negatively affect the health of children were typically much lower when presented with actual ailments in our current study rather than being asked whether, generally speaking, ETS can harm the health of children.

Another study found a statistically significant increase between 1999 and 2006 in the perception of risk that SHS has on the development of several diseases (Lonergan et al., 2014). With regard to risk of ETS exposure on the development of ear infections, our study lends support to the idea of increasing awareness in the general population. In 2006, 41.2% of smokers and 48.2% of nonsmokers believed SHS exposure increases risk for ear infections (Lonergan et al., 2014), and our data from 2012 show that 43% of smokers and 51% of nonsmokers said the same. However, although this previous study also found increasing awareness between 1999 and 2006 of the effects of SHS exposure on the development of asthma (from 76.6% to 87.3% in smokers and from 86.2% to 92.2% in nonsmokers; Lonergan et al., 2014), our present study found that only 79% of smokers and 88% of nonsmokers perceive the risks of SHS exposure on the development of asthma. The respondents included in our study were recruited in part from an otolaryngology clinic, so it is possible they were more sensitive to otolaryngologic issues than the general population.

Comparison of the results from our study to those previously reported in the literature shows that although there may be modest improvement in the public's knowledge about the impact of ETS exposure on certain disorder, such as ear infections, the need to educate the public about these risks remains. Even with improvements in the public's knowledge of the risk of ear infections associated with ETS exposure, we found that only about half of the respondents from any group were aware of this association, and our results showed only minimal improvement in this knowledge from previous data collected in 2006. It is important to recognize that these knowledge deficits persist, because this shows that since the publication of these previous studies, efforts to educate the public about the risks of ETS exposure in children have had minimal impact. There remains a need to education the public about these risks.

...Since the publication of previous studies, efforts to educate the public about the risks of ETS exposure in children have had minimal impact.

Counseling parents to adopt smoking bans in their homes and cars may lead to heightened awareness of the harmful effects of ETS on children's health (Drehmer et al., 2012). Because this awareness may be correlated with the implementation of smoking bans in homes and vehicles (Drehmer et al., 2014; Winickoff et al., 2009), it is important that we identify which groups are least likely to be aware of the impact of ETS and counsel the individuals in these groups to adopt smoking bans in their homes and cars to curb children's exposure to ETS.

As illustrated by the results from the present study, current smokers and previous smokers remain less likely than current nonsmokers and those who have never smoked to perceive the negative effects that SHS and THS can have on children's health. Electronic cigarette use was not included in the survey. It is unknown if any study participants were electronic cigarette users and, if they were, whether they considered themselves to be smokers or nonsmokers when completing the survey. Individuals who do not live with children remain less likely than those who do live with children to perceive the negative impacts that SHS can have on children's health. Although there was some statistically significant difference between cohorts as to the harmful effects of THS on children's health, a general lack of awareness remains in all defined groups regarding the dangers of THS exposure.

There is a knowledge gap regarding the risks to child health from SHS and THS in our population. It is more pronounced in people who are current smokers, previous smokers, and those who do not live with children, but it also exists in nonsmokers who have children in their households. The lack of awareness across all cohorts analyzed in this study regarding the dangers posed to children by exposure to THS is particularly striking. When compared with previous studies, it is clear that the lack of knowledge regarding the impacts of ETS exposure on the health of children has remained largely unchanged. Public health education is needed in this area. Our study results can help guide efforts to inform the public of the risks posed to children by exposure to ETS, with emphasis placed on educating the cohorts least likely to be aware of these dangers.

SUPPLEMENTARY DATA

Supplementary data related to this article can be found at <http://dx.doi.org/10.1016/j.pedhc.2016.08.008>.

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