
THIRDHAND SMOKE IN VEHICLES

WHAT IS THIRDHAND SMOKE (THS)

- Thirdhand smoke is a term used to describe tobacco smoke contamination that remains after the cigarette is extinguished. (Kuschner, Reddy, Mehrotra, & Paintal, 2011; 4)
- Thirdhand smoke is hazardous exposure resulting from cigarette smoke residue that accumulates in cars, home, and other indoor spaces. THS exposure can take place long after smoking has ceased. (Kuschner, Reddy, Mehrotra, & Paintal, 2011; 4)
- Exposure to thirdhand smoke can occur through the skin, by breathing, and by ingestion long after smoke has cleared from a room. (Kuschner, Reddy, Mehrotra, & Paintal, 2011; 4)

THIRDHAND SMOKE IS DANGEROUS

- Thirdhand smoke may be toxic. Nicotine (not a carcinogen) deposited on surfaces can react with ambient nitrous acid to produce tobacco specific nitrosamines (TSNA) which include carcinogenic compounds. (Kuschner, Reddy, Mehrotra, & Paintal, 2011; 4)
- Substantial TSNA levels were measured in the passenger compartment of a light duty pick-up truck in which the driver routinely smoked while commuting. Investigators concluded that given the rapid absorption and persistence of high levels of nicotine on indoor surfaces, this newly identified process results in continuing exposure to hazardous TSNA's long after smoke is cleared. (Kuschner, Reddy, Mehrotra, & Paintal, 2011; 4)
- Within the small enclosed microenvironment of a car, air concentrations of tobacco smoke pollution can reach extremely high levels during active smoking. (Fortmann, et al., October 2010)

PROTECTION FROM THIRDHAND SMOKE

- There is no evidence that THS exposure can be reduced by: using fans, opening windows or using air conditioners. (Kuschner, Reddy, Mehrotra, & Paintal, 2011; 4)
- To eliminate the health risks associated with THS, it would be necessary to remove the furniture, carpets, drapes, curtains and wallboards of contaminated spaces. (Kuschner, Reddy, Mehrotra, & Paintal, 2011; 4)
- The illusion of privacy and separation inherent to cars may also lead smokers to believe that smoking in the car while driving alone does not affect other persons using the vehicle at a later point in time. However, the presence of residual tobacco smoke pollution in the private cars of smokers for sale in the used car market indicates that the assumption is false. (Fortmann, et al., October 2010)
- Research from controlled laboratory studies suggest that some materials used in car interiors may be particularly good secondhand smoke reservoirs, including upholstery, carpeting, and ceiling liners. (Matt, et al., September 2008)

References

- Fortmann, A. L., Romero, R. A., sklar, M., Pham, V., Zakarian, J., Quintana, P. J., et al. (October 2010). Residual Tobacco Smoke in Used Cars: Futile Efforts and Persistent Pollutants. *Nicotine & Tobacco Research*, 1029-1036.
- Kuschner, W. G., Reddy, S., Mehrotra, N., & Paintal, H. S. (2011; 4). Electronic Cigarettes and Thirdhand Tobacco Smoke: Two Emerging Health Care Challenges for the Primary Care Provider. *Int J Gen Med*, 115-120.
- Matt, G. E., Quintana, P. J., Hovell, M. F., Chatfield, D., Ma, D. S., Romero, R., et al. (September 2008). Residual Tobacco Smoke Pollution in Used Cars For Sale: Air, Dust adn Surfaces. *Nicotine & Tobacco Research*, 1467-1475.

Study/Article: Electronic cigarettes and thirdhand tobacco smoke: two emerging health care challenges for the primary care provider

Authors

Ware G Kuschner, Sunayana Reddy, Nidhi Mehrotra, and Harman S Paintal

Publication/Source & Date

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[10.2147/IJGM.S16908](https://doi.org/10.2147/IJGM.S16908)
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Abstract

The term thirdhand smoke first appeared in the medical literature in 2009 when investigators introduced the term to describe residual tobacco smoke contamination that remains after the cigarette is extinguished. Thirdhand smoke is a hazardous exposure resulting from cigarette smoke residue that accumulates in cars, homes, and other indoor spaces. Tobacco-derived toxicants can react to form potent cancer causing compounds. Exposure to thirdhand smoke can occur through the skin, by breathing, and by ingestion long after smoke has cleared from a room. Counseling patients about the hazards of thirdhand smoke may provide additional motivation to quit smoking.

Key Points

- Nicotine can persist in ceiling tiles for up to 30 years.
- Thirdhand smoke may be toxic. Nicotine (not a carcinogen) deposited on surfaces can react with ambient nitrous acid to produce tobacco specific nitrosamines (TSNA) which include carcinogenic compounds.
- SHS exposure happens when a nonsmoker is exposed to a burning tobacco product. THS exposure can take place long after smoking has ceased.
- THS is particularly dangerous for children who play or crawl on contaminated surfaces.
- There is no evidence that THS exposure can be reduced by: using fans, opening windows, or using air conditioners.
- Parents who understand THS are more likely to ban smoking in their homes.
- To eliminate the health risks associated with thirdhand smoke, it would be necessary to remove the furniture, carpets, drapes, curtains and wallboards of contaminated spaces.
- Substantial TSNA levels were measured in the passenger compartment of a light duty pick-up truck in which the driver routinely smoked while commuting. Investigators concluded that given the rapid sorption and persistence of high levels of nicotine on indoor surfaces, this newly identified process results in continuing exposure to hazardous TSNA's long after smoke is cleared.
- Dermal exposure, dust inhalation, and ingestion are all potential routes of exposure to these toxic compounds.
- Nicotine deposits readily on surfaces and gradually outgases. Simulation of intense indoor smoking found no threshold for the adsorption of nicotine to wallboard. Accordingly, standard indoor domestic walls are likely to serve as high capacitance reservoirs for nicotine which can then be converted to TSNA's as described above.

Study/Article

Residual Tobacco Smoke in Used Cars: Futile Efforts and Persistent Pollutants

Authors

Addie L. Fortmann, M.S.,¹ Romina A. Romero, M.P.H.,²
Marisa Sklar, M.S.,³ Viet Pham, B.A.,³ Joy Zakarian, M.P.H.,⁴
Penelope J. E. Quintana, Ph.D., M.P.H.,⁵ Dale Chatfield,
Ph.D.,⁶ & Georg E. Matt, Ph.D.⁷

Publication/Source & Date

Nicotine & Tobacco
Research, Volume 12,
Number 10 (October 2010)
1029–1036

Abstract

Introduction: Smoking cigarettes in the enclosed environment of a car leads to the contamination of a car's microenvironment with residual tobacco smoke pollution (TSP).

Methods: Surface wipe, air, and dust samples were collected in used cars sold by nonsmokers ($n = 40$) and smokers ($n = 87$) and analyzed for nicotine. Primary drivers were interviewed about smoking behavior and restrictions, and car interiors were inspected to investigate (a) differences in car dustiness, signs of past smoking, ventilation use, mileage, and passenger cabin volume among nonsmokers and smokers with and without in-car smoking bans and (b) factors that contribute to the contamination of cars with residual TSP, such as ventilation use, cleaning behaviors, signs of past smoking, and holding the cigarette near/ outside the car window while smoking.

Results: Smokers reported using air conditioning less ($p < .05$) and driving with windows down more often than nonsmokers ($p = .05$); their cars were also dustier ($p < .01$) and exhibited more ash and burn marks than nonsmokers' cars ($p < .001$). Number of cigarettes smoked by the primary driver was the strongest predictor of residual TSP indicators ($R^2 = .10 - .16$, $p = .001$). This relationship was neither mediated by ash or burn marks nor moderated by efforts to remove residual TSP from the vehicle (i.e., cleaning, ventilation) or attempts to prevent tobacco smoke pollutants from adsorbing while smoking (e.g., holding the cigarette near/outside window).

Discussion: Findings suggest that smokers can prevent their cars from becoming contaminated with residual TSP by reducing or ceasing smoking; however, commonly used cleaning and ventilation methods did not successfully decrease contamination levels. Disclosure requirements and smoke-free certifications could help protect buyers of used cars and empower them to request nonsmoking environments or a discount on cars that have been smoked in previously.

Key Points

- Within the small enclosed microenvironment of a car, air concentrations of TSP can reach extremely high levels during active smoking.
- respirable fine particle concentrations (PM_{2.5}) could exceed 2,000–3,000 mg/m³ in a moving vehicle with windows closed.
- the U.S. Environmental Protection Agency's Air Quality Index for particle pollution designates levels exceeding 250 mg/m³ as "hazardous,"
- As cigarettes are smoked over time, pollutants amass on indoor surfaces, leading to greater concentrations of residual TSP.
- The illusion of privacy and separation inherent to cars may also lead smokers to believe that smoking in the car while driving alone does not affect other persons using the vehicle at a later point in time. However, the presence of residual TSP in the private cars of smokers for sale in the used car market indicates that this assumption is false.
- unlike other kinds of personal property, a car may be resold, leased, rented (i.e., rental cars), and/or borrowed by several owners/drivers over its lifetime, thus increasing the number of nonsmokers, including children (a subgroup of smokers at elevated risk), who may be exposed to residual TSP inside the vehicle

Study/Article: Residual tobacco smoke pollution in used cars for sale: Air, dust, and surfaces

Authors Georg E. Matt, Penelope J. E. Quintana, Melbourne F. Hovell, Dale Chatfield, Debbie S. Ma, Romina Romero, Anna Uribe	Publication/Source & Date Nicotine & Tobacco Research Volume 10, Number 9 (September 2008) 1467–1475
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Abstract
Regular tobacco use in the enclosed environment of a car raises concerns about longer-term contamination of a car's microenvironment with residual secondhand smoke pollutants. This study (a) developed and compared methods to measure residual contamination of cars with secondhand smoke, (b) examined whether cars of smokers and nonsmokers were contaminated by secondhand smoke, and (c) how smoking behavior and restrictions affected contamination levels. Surface wipe, dust, and air samples were collected in used cars sold by nonsmokers (n520) and smokers (n587) and analyzed for nicotine. Sellers were interviewed about smoking behavior and restrictions, and car interiors were inspected for signs of tobacco use. Cars of smokers who smoked in their vehicles showed significantly elevated levels of nicotine (p,.001) in dust, on surfaces, and in the air compared with nonsmoker cars with smoking ban. When smokers imposed car smoking bans, air nicotine levels were significantly lower (p,.01), but dust and surface contamination levels remained at similar levels. Smoking more cigarettes in the car and overall higher smoking rate of the seller were significantly associated with higher secondhand smoke contamination of the car (p,.001). Use of a cut point for nicotine levels from surface wipe samples correctly identified 82% of smoker cars without smoking bans, 75% of smoker cars with bans, and 100% of nonsmoker cars. Surface nicotine levels provide a relatively inexpensive and accurate method to identify cars and other indoor environments contaminated with residual secondhand smoke. Disclosure requirements and smoke-free certifications could help protect nonsmoking buyers of used cars.

- Key Points**
- Research from controlled laboratory studies suggest that some materials used in car interiors may be particularly good secondhand smoke reservoirs, including upholstery, carpeting, and ceiling liners

Study/Article: Formation of carcinogens indoors by surface-mediated reactions of nicotine with nitrous acid, leading to potential thirdhand smoke hazards.

Authors
Sleiman M, Gundel LA, Pankow JF, Jacob P 3rd, Singer BC, Destailats H.

Publication/Source & Date
Proc Natl Acad Sci U S A. 2010 Apr 13;107(15):6576-81. Epub 2010 Feb 8.

Abstract

This study shows that residual nicotine from tobacco smoke sorbed to indoor surfaces reacts with ambient nitrous acid (HONO) to form carcinogenic tobacco-specific nitrosamines (TSNAs). Substantial levels of TSNAs were measured on surfaces inside a smoker's vehicle. Laboratory experiments using cellulose as a model indoor material yielded a > 10-fold increase of surface-bound TSNAs when sorbed secondhand smoke was exposed to 60 ppbv HONO for 3 hours. In both cases we identified 1-(N-methyl-N-nitrosamino)-1-(3-pyridinyl)-4-butanal, a TSNA absent in freshly emitted tobacco smoke, as the major product. The potent carcinogens 4-(methylnitrosamino)-1-(3-pyridinyl)-1-butanone and N-nitroso nornicotine were also detected. Time-course measurements revealed fast TSNA formation, with up to 0.4% conversion of nicotine. Given the rapid sorption and persistence of high levels of nicotine on indoor surfaces-including clothing and human skin-this recently identified process represents an unappreciated health hazard through dermal exposure, dust inhalation, and ingestion. These findings raise concerns about exposures to the tobacco smoke residue that has been recently dubbed "thirdhand smoke." Our work highlights the importance of reactions at indoor interfaces, particularly those involving amines and NO(x)/HONO cycling, with potential health impacts.

Key Points

- nicotine residue can combine with other particles in the air to create cancer-causing substances.
- Young children may come in contact with these cancer-causing substances frequently because they crawl on the floor and often put contaminated objects in their mouths. Children also breathe faster than adults, so when they breathe the air around them they will be inhaling more harmful substances compared to their body size

Study/Article: Beliefs About the Health Effects of "Thirdhand" Smoke and Home Smoking Bans

Authors
Jonathan Winickoff, Joan Friebely, Susanne E. Tanski, Cheryl Sherrod, Georg E. Matt, Melbourne F. Hovell, Robert C. McMillen

Publication/Source & Date
Pediatrics, Volume 123, Number 1, January 2009: e74-e79

Abstract

OBJECTIVE: There is no safe level of exposure to tobacco smoke. Thirdhand smoke is residual tobacco smoke contamination that remains after the cigarette is extinguished. Children are uniquely susceptible to thirdhand smoke exposure. The objective of this study was to assess health beliefs of adults regarding thirdhand smoke exposure of children and whether smokers and nonsmokers differ in those beliefs. We hypothesized that beliefs about thirdhand smoke would be associated with household smoking bans.

METHODS. Data were collected by a national random-digit-dial telephone survey from September to November 2005. The sample was weighted by race and gender within

Census region on the basis of US Census data. The study questions assessed the level of agreement with statements that breathing air in a room today where people smoked yesterday can harm the health of children.

RESULTS. Of 2000 eligible respondents contacted, 1510 (87%) completed surveys, 1478 (97.9%) answered all questions pertinent to this analysis, and 273 (18.9%) were smokers. Overall, 95.4% of nonsmokers versus 84.1% of smokers agreed that secondhand smoke harms the health of children, and 65.2% of nonsmokers versus 43.3% of smokers agreed that thirdhand smoke harms children. Strict rules prohibiting smoking in the home were more prevalent among nonsmokers: 88.4% vs 26.7%. In multivariate logistic regression, after controlling for certain variables, belief that thirdhand smoke harms the health of children remained independently associated with rules prohibiting smoking in the home. Belief that secondhand smoke harms the health of children was not independently associated with rules prohibiting smoking in the home and car.

CONCLUSIONS. This study demonstrates that beliefs about the health effects of thirdhand smoke are independently associated with home smoking bans. Emphasizing that thirdhand smoke harms the health of children may be an important element in encouraging home smoking bans.

Key Points

- People who believe that thirdhand smoke harms children are more likely to have a strict smoking ban in their homes. Knowledge of the effects of thirdhand smoke was an even greater predictor than knowledge of the effects of secondhand smoke.
- New information emerging about thirdhand smoke exposure may offer families needed additional information about sources of possible toxic exposure of their children and may enhance their motivation to alter home smoking practices to protect better the health of children.
- Children are especially susceptible to thirdhand smoke exposure because they breathe near, crawl and play on, touch, and mouth contaminated surfaces. The dust ingestion rate in infants is more than twice that of adults.
- Similar to low levels of lead exposure, low levels of tobacco smoke markers have been associated with cognitive deficits among children. The highest tobacco exposure levels were associated with the lowest reading scores; however, the lowest levels of exposure were associated with the steepest slope in the decrement in reading levels. These facts underscore the possibility that compounds in tobacco smoke are neurotoxic at extremely low levels and the prudence of absolute restriction of all smoking in indoor areas inhabited by children.

Study/Article: Does the Smoke Ever Really Clear? Thirdhand Smoke Exposure Raises New Concerns

Authors
Adrian Burton

Publication/Source & Date
Environmental Health Perspectives • volume 119 |
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Abstract

None – magazine article

Key Points

- Although concern that THS might be a hazard has grown, proof of harm remains to be formally demonstrated.