

I would submit that conventional usage and the avoidance of unusual and highly specialized interpretations remain the best practice.

Lloyd B. Tepper, MD, ScD
Adjunct Professor
University of Pennsylvania
Philadelphia, Penn

Asthma Induced by Exposure to Spray Polyurethane Foam Insulation in a Residential Home

Spray polyurethane foam (SPF) has recently become a popular “green” solution for insulation systems in residential homes and office buildings in the United States because of its high efficiency, low cost, and eligibility for federal energy tax credits in 2011. All SPFs contain isocyanates that are known to cause occupational asthma,¹ but the occurrence of asthma in occupants of homes and building in which SPF is used for energy retrofits has not been reported.

CASE

A 36-year-old man and a 38-year-old woman living in the same household presented to the pulmonary clinic for evaluation of persistent cough and dyspnea upon exertion. They had moved into a home 18 months previously and had SPF installed in the attic. The patients followed the recommended precautions by evacuating the home for 4 hours. On returning, the patients noted a strong noxious odor, and almost immediately they developed cough, dyspnea, dizziness, nausea, headache, and watery eyes. Several attempts were made to abate the odor by venting the attic, keeping the windows open, and eventually removing the SPF, but the symptoms persisted. After 3 months, the family finally vacated the home. Neither patient had significant medical history. Both were nonsmokers and worked in office-based professions with no exposure to occupational hazards. Both had normal physical examinations, normal routine laboratory tests, including complete blood count and metabolic panels, and normal pulmonary function tests. Both patients showed a positive methacholine challenge test with

the methacholine concentration that causes a 20% decrease in forced expiratory volume in 1 second (PC₂₀) of 8 mg/mL for the male patient and 1 mg/mL for the female patient (Fig. 1). The SPF used in our patients' home was a two-component SPF system (Sealection[®] 500; Dimilec USA, LLC, Arlington, TX) that contained polymeric diphenylmethane diisocyanate (MDI) (50% to 60%), 4,4'-MDI (35% to 45%), and 2,4'-MDI (1% to 5%) in side A. Both patients were diagnosed with asthma or reactive airway dysfunction syndrome induced by exposure to isocyanates and were treated with bronchodilators and inhaled steroids.²

DISCUSSION

Isocyanates are traditionally used in the automotive, aerospace, metal-working, and wood-working industries.³ They are the most common cause of new onset work-related asthma.⁴ The use of isocyanates in nonoccupational settings has increased recently, primarily because of the popularity of SPF as an insulation material for residential homes. The home occupants may unknowingly be exposed to isocyanates and be at increased risk for adverse health effects.

The “curing” rate of SPF, that is, the time for chemicals in the product to react to produce polyurethane foam, is an important determinant for health effects and varies from 7 to 72 hours depending on the type of SPF product, applicator technique, foam thickness, temperature, and humidity. This curing rate will impact the “re-entry time.” Our patients were told to return 4 hours after the application was completed, and thus were likely exposed to high concentrations of MDI. The clear exposure history, symptoms/signs of asthma, and positive methacholine challenge test established the diagnosis of isocyanate-induced asthma.

To our knowledge, this report is the first to describe asthma associated with household exposure to isocyanates contained in SPF. The use of SPF in residential homes likely will continue to increase. This new source of exposure potentially puts a large population at risk for adverse health effects. In response to a growing number of complaints about adverse health effects from homeowners and occupants of office buildings, the US Environmental Protection Agency has recently published an action

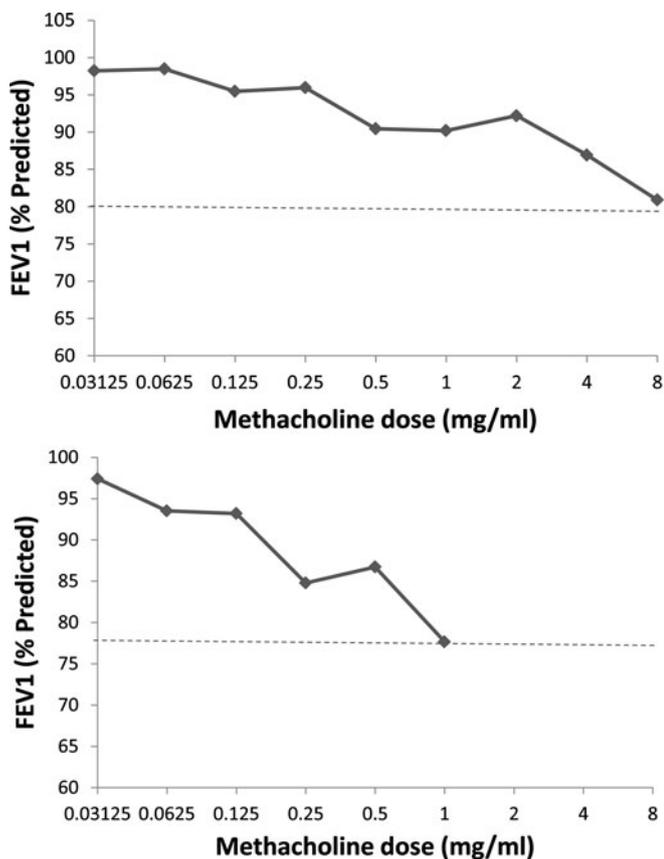


FIGURE 1. Results of methacholine challenge tests for the two patients. The tests were done 16 months after the initial exposure. **A**, For the male patient, the PC₂₀ is 8 mg/mL. **B**, For the female patient, the PC₂₀ is 1 mg/mL. The dashed line indicates a decrease of 20% in forced expiratory volume in 1 second.

Disclosure: The authors have no conflicts of interest to declare.

Copyright © 2012 by American College of Occupational and Environmental Medicine
DOI: 10.1097/JOM.0b013e31824d2a1

plan to control exposure to MDI for homeowners and “do-it-yourselfers.”⁵ Clinicians should be vigilant about this novel exposure scenario to isocyanates when managing patients with new-onset or worsening asthma.

Wayne Tsuang, MD
Yuh-Chin T. Huang, MD, MHS, FCCP
 Department of Medicine
 Duke University Medical Center
 Durham, NC

REFERENCES

1. Redlich CA, Stowe MH, Coren BA, Wisniewski AV, Holm CT, Cullen MR. Diisocyanate-exposed auto body shop workers: a one-year follow-up. *Am J Ind Med.* 2002;42:511–518.
2. Brooks SM, Weiss MA, Bernstein IL. Reactive airways dysfunction syndrome (RADS). Persistent asthma syndrome after high level irritant exposures. *Chest.* 1985;88:376–384.
3. Fisseler-Eckhoff A, Bartsch H, Zinsky R, Schirren J. Environmental isocyanate-induced asthma: morphologic and pathogenetic aspects of an increasing occupational disease. *Int J Environ Res Public Health.* 2011;8:3672–3687.
4. Goe SK, Henneberger PK, Reilly MJ, et al. A descriptive study of work aggravated asthma. *Occup Environ Med.* 2004;61:512–517.
5. US Environmental Protection Agency. Spray Polyurethane Foam (SPF) Home. Available at: <http://epa.gov/dfe/pubs/projects/spf/spray-polyurethane.foam.html>. Accessed December 2, 2011.

Validation of the Sex Difference in the Trend of Carotid Artery Intima Media Thickness by the Number of Metabolic Components: Is This a Result Related to Occupational Factors?

To the Editor:

Hartley et al¹ examined the association between metabolic syndrome (MetS) and the carotid artery intima media thickness (IMT) in male and female police of-

ficers. They measured three carotid IMT variables, and the mean common carotid artery (CCA) IMT was measured in 12 CCA segments measuring approximately 10 mm in length: the near and far wall and, from three interrogation angles, on both the right and left sides (2 walls × 3 angles × 2 sides = 12). I would be very interested in the sex difference of the mean carotid artery IMT, especially the mean CCA-IMT, stratified by the number of MetS components. Although Iglesias del Sol et al² examined the differences in the predictive ability of the measurement sites for future myocardial infarction and concluded that the IMT of the CCA, carotid bifurcation, and internal carotid artery showed the same predictive ability, Polak et al³ reported a cohort survey and showed that the CCA-IMT, rather than the IMT at the carotid artery bulb and internal carotid arteries, can be explained by traditional cardiovascular risk factors.

Hartley et al¹ conducted an analysis of variance with statistical adjustments for age, smoking status and low-density lipoprotein cholesterol. In addition, a trend test was performed to check the linearity of the IMT values. The results revealed that the unadjusted mean CCA-IMT was significantly and positively associated with number of MetS components among 106 women

and among 304 men, respectively. However, the significant association was no longer seen among men after the adjustments. The percentage of subjects younger than 50 years was 84.6% in the males and 91.6% in the females in their study. The prevalence of MetS in their study was 26.1% but its prevalence in the male officers was higher than that in the female officers (32.2% vs 8.5%). In addition, a half of the female officers had no MetS components.

Several reports have indicated that the influence of MetS on the early progression of atherosclerosis may be stronger in women than in men,^{4–7} which lends support to the sex-related difference presented by Hartley et al.¹ However, the age and occupation of the subjects varied among the reports. Is this result related to occupational factors?

I want to present the opposite results by fitting the same analysis procedure as that conducted by Hartley et al.¹ A total of 771 subjects (669 males and 102 females) were included in our intensive health examination. Their age ranged from 35 to 59 years and the mean (standard deviation) ages were 45.8 (7.0) years in males and 49.5 (7.2) years in females. The type of job could not be specified, and percentages of workers with income were 93.8% in males and 50.0% in females in this study. The prevalence of

TABLE 1 Unadjusted and Adjusted Mean Values of Carotid Artery Thickness by Number of Metabolic Syndrome Components and Sex*

	Number of Metabolic Syndrome Components				P†
	0	1	2	≥3	
Left mean CCA-IMT					
Male	N = 160	N = 187	N = 130	N = 192	
Unadjusted	0.519 (0.118)	0.544 (0.108)	0.580 (0.128)	0.659 (0.177)	<0.001
Age adjusted	0.534 (0.010)	0.547 (0.009)	0.581 (0.011)	0.643 (0.009)	<0.001
Multivariate adjusted‡	0.535 (0.010)	0.546 (0.009)	0.582 (0.011)	0.642 (0.009)	<0.001
Female	N = 37	N = 35	N = 14	N = 16	
Unadjusted	0.500 (0.118)	0.563 (0.142)	0.571 (0.099)	0.556 (0.089)	ns
Age adjusted	0.510 (0.019)	0.562 (0.019)	0.566 (0.030)	0.542 (0.028)	ns
Multivariate adjusted‡	0.508 (0.019)	0.563 (0.020)	0.567 (0.031)	0.541 (0.029)	ns
Right mean CCA-IMT					
Male	N = 160	N = 187	N = 130	N = 192	
Unadjusted	0.516 (0.121)	0.535 (0.107)	0.582 (0.131)	0.642 (0.195)	<0.001
Age adjusted	0.530 (0.011)	0.539 (0.010)	0.583 (0.012)	0.626 (0.010)	<0.001
Multivariate adjusted‡	0.532 (0.011)	0.538 (0.010)	0.583 (0.012)	0.625 (0.010)	<0.001
Female	N = 37	N = 35	N = 14	N = 16	
Unadjusted	0.508 (0.121)	0.549 (0.122)	0.550 (0.094)	0.531 (0.060)	ns
Age adjusted	0.517 (0.017)	0.547 (0.017)	0.545 (0.028)	0.518 (0.026)	ns
Multivariate adjusted‡	0.517 (0.018)	0.547 (0.018)	0.546 (0.028)	0.518 (0.026)	ns

*Values are mean (SD) for unadjusted model or (SE) for adjusted models.

†Test for linear trend based on linear contrast.

‡Adjusted for age, smoking status, and low-density lipoprotein cholesterol.

CCA indicates common carotid artery; IMT, intima media thickness; ns, not significant for trend analysis.

The author declares no conflict of interest regarding this study.

Copyright © 2012 by American College of Occupational and Environmental Medicine
 DOI: 10.1097/JOM.0b013e3182300424