

**Abstracts of Recent NIOSH Peer-Reviewed Publications from Field-Based Studies of Hazards, Health, Risk and Controls**

**2002**

***TITLE: Evaluation of Self-Reported Skin Problems Among Workers Exposed to Toluene Diisocyanate (TDI) at a Foam Manufacturing Facility***

AUTHORS: Daftarian HS, Lushniak BD, Reh CM, Lewis DM

SOURCE: J Occup Environ Med 2002; 44:1197-1202

ABSTRACT: Toluene diisocyanate, or TDI (CAS 584-84-9) is a well-known asthmagen and respiratory irritant. TDI is also known for its ability to irritate the skin and mucous membranes. To further investigate the dermal effects of TDI, NIOSH investigators conducted a cross-sectional study at a flexible foam manufacturing plant. A total of 114 workers participated in the study. Participants completed a medical questionnaire, provided blood for antibody testing to TDI and other allergens, and a subset of participants reporting skin symptoms underwent skin patch testing to a standard diisocyanate panel. Production line workers were more than twice as likely to report skin problems as those working in nonproduction areas (PRR = 2.66; 95% CI = 1.14-16.32; P = 0.02). Age, gender and duration of employment at the plant were comparable among participants working in production and nonproduction areas. Of the 100 participants who provided blood samples for antibody testing, specific IgG antibody to TDI was detected in two individuals, and none of the samples demonstrated specific IgE antibody to TDI. Of the 26 workers who underwent skin patch testing, none developed reactions to the diisocyanate allergens. These results suggest that the skin symptoms among study participants represent an irritant rather than an immunologic reaction to TDI, or to an unidentified allergen present in the foam.

**2001**

***TITLE: Determinants of chlorpyrifos exposures and urinary 3,5,6-trichloro-2-pyridinol levels among termiticide applicators***

AUTHORS: Hines C, Deddens JA

SOURCE: Ann Occup Hyg 2001; 45:309-321

ABSTRACT: The exposures and work activities of 41 applicators in North Carolina using chlorpyrifos-containing termiticides were characterized. Personal air and urine samples were collected on multiple days within one week. Detailed information about chemical use, tasks, personal protective equipment and hygiene was recorded. During the 202 applicator-days monitored, 415 treatment jobs were performed. Full-shift chlorpyrifos exposures ranged from <0.048 to 110  $\mu\text{g}/\text{m}^3$  (N=184), with a geometric mean (GM) of 10  $\mu\text{g}/\text{m}^3$ . Urinary 3,5,6-trichloro-2-pyridinol (TCP) levels ranged from 9.42 to 1960  $\mu\text{g}/\text{g}$  creatinine (N=271) and varied significantly by day of the week (GM range: 169–262  $\mu\text{g}/\text{g}$  creatinine). Predictive models for chlorpyrifos air exposure and urinary TCP levels were developed using mixed-effects stepwise linear regression. Determinants of airborne chlorpyrifos exposure included minutes chlorpyrifos applied and enclosed crawl space treated (yes/no). Determinants of TCP levels (depending on the model) included day-of-the-week, the chlorpyrifos air concentration one and two days before urine collection, minutes of chlorpyrifos applied one and two days before urine collection, enclosed crawl space treated (yes/no), and commercial structure treated (time-weighted). Within- and between-worker variability was similar for airborne chlorpyrifos; however, for TCP, between-worker variability exceeded within-worker variability by six times. The elimination half-life of TCP

(26.9 h) and possibly the short sampling interval (one week) may explain the low TCP within-worker variability. Applicators' weekly mean ln(TCP levels) and weekly mean ln(chlorpyrifos air concentrations) were highly and positively linearly correlated ( $r^2=0.73$ ,  $P<0.0001$ ). In summary, mixed-effects models were successfully constructed to predict airborne chlorpyrifos exposure and urinary TCP levels.

***TITLE: Distributions and Determinants of Pre-emergent Herbicide Exposures Among Custom Applicators***

AUTHORS: Hines CJ, Deddens JA, Tucker SP, Hornung RW

SOURCE: Ann Occup Hyg 2001; 45:227-239

ABSTRACT: Custom applicators intensively apply herbicides to corn and soybean fields each spring. The primary objective of this study was to characterize the exposure distributions of the herbicides alachlor, atrazine, 2,4-D 2-ethylhexyl ester (2,4-D EH), and metolachlor among a group of applicators during the spring pre-emergent spray season. A secondary objective was to evaluate determinants of exposure and to estimate within- and between-worker variance components. Fifteen applicators were sampled using a systematic design that included spray and non-spray days and multiple measurements (five to seven) on each applicator. Air, patch, and handwash samples were collected on 89 applicator-days. Applicator-days were classified into three categories: target herbicide sprayed, non-target herbicide sprayed, and no herbicide sprayed. Mixed-model regression analysis was used. For all exposure metrics, adjusted mean herbicide exposures were significantly higher on days when target herbicides were sprayed as compared to non-spray days. For 2,4-D EH only, adjusted mean exposures on non-target herbicide spray days were significantly higher than on non-spray days. Wearing gloves significantly reduced adjusted mean hand exposure for all herbicides (4–20 fold) and adjusted mean thigh exposure for three herbicides (8–53 fold) on days the herbicides were sprayed; however, wearing gloves significantly increased adjusted mean atrazine hand and thigh exposures (9 and 7 fold, respectively) on days that non-atrazine herbicides were sprayed. Few of the other covariates were consistent determinants of exposure. For all exposure metrics, the within-worker variability (GSDW 2.1–5.6) was greater than the between-worker variability (GSDB 1.2–2.7).

**2000**

***TITLE: Commentary: Exposure and Absorption of Hazardous Materials Through the Skin***

AUTHORS: Boeniger MF, Lushniak BD

SOURCE: Int J Occup Environ Health 2000; 6:148-150

ABSTRACT: The early work of pioneering researchers has helped others recognize the potential importance of skin exposures and has raised an awareness of the need to protect workers and the public from these exposures. The ramifications of exposure of the skin to toxic chemicals are still poorly understood. Although laboratory-based in-vitro and in-vivo testing has produced permeation rates for many compounds, the use of different experimental methods to obtain these rates has produced dissimilar results. Qualitative guidance criteria, provided as "skin notations," have been adopted by workplace exposure standards organizations worldwide as footnotes to air concentration limits. The process by which chemicals have been identified as skin-absorption hazards by these standards-setting organizations has been criticized as inconsistent and often poorly documented. Several approaches have been proposed for both improving the identification of notation-worthy chemicals and improving the consistency of the justifying documentation. Some have advocated the eventual establishment of quantitative dermal occupational exposure limits. It can be argued that the paucity of available data does not currently permit establishment of any guidelines, but some approaches have been proposed. The

21st century will bring further advances and expand our knowledge in the fields of occupational and environmental skin exposures and direct and systemic health effects from such exposures.

***TITLE: Hand wash and manual skin wipes***

AUTHORS: Brouwer DH, Boeniger MF, van Hemmen J

SOURCE: Ann Occup Hyg 2000; 44:501-510.

ABSTRACT: Hand wash and skin wipes are major techniques that have been used for dermal exposure sampling. Both techniques remove chemicals either deposited on or transferred to the skin contaminant layer by a combination of chemical and mechanical actions. The paper overviews identified methods and techniques, with emphasis on sampling parameters and sampling efficiency. It is concluded that identified sampling protocols, including sampling techniques, deviate at possible key issues, which hampers comparisons of study results. It is recommended to conduct sampling efficiency studies prior to field sampling, under conditions that are quite similar to conditions of exposure regarding exposure process, levels of skin loading, and time of residence of the compound on the skin. Harmonization of sampling protocols will be a first step in creating a database for better understanding the influence of sampling parameters on the performance of removal techniques to assess dermal exposure.

**1998**

***TITLE: Occupational dermatitis causing days away from work in US private industry.***

AUTHORS: Burnett CA, Lushniak BD, McCarthy W, Kaufman J

SOURCE: Amer J Industr Med 1998; 34:568-573

ABSTRACT: Occupational skin disease is an important cause of disability in the workplace. The aim of this report is to estimate the incidence of occupational dermatitis cases that causes days away from work and to characterize the cases. The Annual Survey of Occupational Injuries and Illnesses from the Bureau of Labor Statistics collects employer reports on work-related dermatitis. Descriptive data are collected on a sample of the cases that result in days away from work. Estimates of the number of cases and days away from work were calculated by industry, occupation, and exposure source. In 1993, there were an estimated 8,835 cases of occupational dermatitis, a rate of 1.12/10,000 workers. The largest number of cases was in health services, while the highest rate was in agricultural crops. The occupation with the largest number of cases was non-construction laborers. Cleaning/polishing agents caused the largest number of cases. Calcium hydroxide and oxides caused a median of nine days away from work. The survey data show that the effect of occupational dermatitis is substantial in the lives of workers. These descriptive data should be used to target interventions.

***TITLE: Cancer Risks Among Workers Exposed to Metalworking Fluids: A Systematic Review***

AUTHORS: Calvert GM, Ward E, Schnorr TM, Fine LJ

SOURCE: Am J Ind Med 1998; 33:282-292

ABSTRACT: Metalworking fluids (MWFs) are commonly used in a variety of industrial machining and grinding operations. The National Institute for Occupational Safety and Health (NIOSH) estimates that more than one million workers are exposed to MWFs. NIOSH conducted a comprehensive and systematic review of

the epidemiologic studies that examined the association between MWF exposure and cancer. Substantial evidence was found for an increased risk of cancer at several sites (larynx, rectum, pancreas, skin, scrotum, and bladder) associated with at least some MWFs used prior to the mid-1970s. This paper provides the evidence pertaining to cancer at these sites. Cancer at those sites found to have more limited or less consistent evidence for an association with MWF (stomach, esophagus, lung, prostate, brain, colon, and hematopoietic system) will not be discussed in this paper but are discussed in the recent NIOSH Criteria for a Recommended Standard-Occupational Exposure to MWFs. Because the changes in MWF composition that have occurred over the last several decades may not be sufficient to eliminate the cancer risks associated with MWF exposure, reductions in airborne MWF exposures are recommended.