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Solvents:

An Interdisciplinary Annotated Bibliography

CPWR - The Center for Construction Research and Training

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8484 Georgia Avenue
Suite 1000
Silver Spring, MD 20910

PHONE: 301.578.8500
FAX: 301.578.8572

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Solvents: An Interdisciplinary Annotated Bibliography

Azaroff, L. S., et al. (2006). "Protecting workers and residents from wood floor-finishing hazards." New Solut 16(2): 119-138.

The recent deaths of three hardwood floor finishers in the Boston area have highlighted the urgency of addressing hazards in this industry. Among other dangers to health and safety, fire is a constant threat in a work setting that combines highly flammable solvents, large quantities of airborne wood dust, electrical equipment, heat, and friction inside old homes. Immigrant workers, who perform a large proportion of this work, are at special risk. An Environmental Justice partnership of community-based organizations, community health centers, and environmental health researchers funded by the National Institute of Environmental Health Sciences (the "Dorchester Occupational Health Initiative") had been studying the occupational health of hardwood floor finishing when these workers died. This preparation enabled community, health, labor, business, and political leaders to mobilize a response and release recommendations within weeks of the second fatal fire. Their report, adapted below, contains important information for health and labor activists in all areas where wood flooring is common. Most notably, the use of less flammable (higher flash point) products can help reduce the risk of more fatal fires. For further information, please contact the Massachusetts Coalition for Occupational Safety and Health, masscosh.org.

Dement, J., et al. (2018). "Hearing loss among older construction workers: Updated analyses." Am J Ind Med 61(4): 326-335.

BACKGROUND: A prior study of this construction worker population found significant noise-associated hearing loss. This follow-up study included a much larger study population and consideration of additional risk factors. METHODS: Data included audiometry, clinical chemistry, personal history, and work history. Qualitative exposure metrics for noise and solvents were developed. Analyses compared construction workers to an internal reference group with lower exposures and an external worker population with low noise exposure. RESULTS: Among participants (n = 19 127) an overall prevalence of hearing loss of 58% was observed, with significantly increased prevalence across all construction trades. Construction workers had significantly increased risk of hearing loss compared to reference populations, with increasing risk by work duration. Noise exposure, solvent exposure, hypertension, and smoking were significant risk factors in multivariate models. CONCLUSIONS: Results support a causal relationship between construction trades work and hearing loss. Prevention should focus on reducing exposure to noise, solvents, and cigarette smoke.

Dement, J. M., et al. (2010). "Airways obstruction among older construction and trade workers at Department of Energy nuclear sites." Am J Ind Med 53(3): 224-240.

BACKGROUND: A study of chronic obstructive pulmonary disease (COPD) among 7,579 current and former workers participating in medical screening programs at Department of Energy (DOE) nuclear weapons facilities through September 2008 was undertaken. METHODS: Participants provided a detailed work and exposure history and underwent a respiratory examination that included a respiratory history, respiratory symptoms, a posterior-anterior (P-A) chest radiograph classified by International Labour Office (ILO) criteria, and spirometry. Statistical models were developed to generate group-level exposure estimates that were used in multivariate logistic regression analyses to explore the risk of COPD in relation to exposures to asbestos, silica, cement dust, welding, paints, solvents, and dusts/fumes from paint removal. Risk for COPD in the study population was compared to risk for COPD in the general US population as determined in National Health and Nutrition Examination

Survey (NHANES III). RESULTS: The age-standardized prevalence ratio of COPD among DOE workers compared to all NHANES III data was 1.3. Internal analyses found the odds ratio of COPD to range from 1.6 to 3.1 by trade after adjustment for age, race, sex, smoking, and duration of DOE employment. Statistically significant associations were observed for COPD and exposures to asbestos, silica, welding, cement dusts, and some tasks associated with exposures to paints, solvents, and removal of paints. CONCLUSIONS: Our study of construction workers employed at DOE sites demonstrated increased COPD risk due to occupational exposures and was able to identify specific exposures increasing risk. This study provides additional support for prevention of both smoking and occupational exposures to reduce the burden of COPD among construction workers.

Fang, F., et al. (2009). "Workplace exposures and the risk of amyotrophic lateral sclerosis." Environ Health Perspect 117(9): 1387-1392.

BACKGROUND: Occupation has been suggested to play a role in amyotrophic lateral sclerosis (ALS) etiology, but detailed information on the importance of specific workplace exposures is lacking. OBJECTIVES: Our aim was to assess the relationship between workplace exposures and the risk of ALS and to evaluate potential interactions between these exposures and smoking. METHODS: We conducted a case-control study in New England between 1993 and 1996, comprising 109 cases and 253 controls who completed a structured interview covering occupations and workplace exposures. Unconditional logistic regression models were used to estimate the odds ratios (ORs) and 95% confidence intervals (CIs) for ALS. Analyses were conducted among the entire study population and after stratification by smoking. RESULTS: We observed a higher risk of ALS for construction workers excluding supervisors (OR = 2.9; 95% CI, 1.2-7.2) and precision metal workers (OR = 3.5; 95% CI, 1.2-10.5). Self-reported exposures to paint strippers; cutting, cooling, or lubricating oils; antifreeze or coolants; mineral or white spirits; and dry cleaning agents each appeared to be associated with a 60-90% higher risk. Specific chemicals related to a > 50% increase in risk of ALS included aliphatic chlorinated hydrocarbons, glycols, glycol ethers, and hexane. Relative risks associated with these workplace exposures and chemicals were greater among nonsmokers and persisted in mutually adjusted models. CONCLUSIONS: Our data suggest that certain occupations and workplace exposures may be associated with increased risk of ALS. These results need to be confirmed in independent populations.

Fiedler, N., et al. (2003). "Cognitive effects of chronic exposure to lead and solvents." Am J Ind Med 44(4): 413-423.

Background: Occupational exposure to lead and solvents has declined steadily over the past 20 years, however, construction workers continue to be exposed to these neurotoxicants. The purpose of this study was to investigate the cognitive effects of chronic occupational exposure to lead and solvents. Method: Based on K-XRF of tibial bone lead and occupational history of solvent exposure, subjects were classified into four exposure groups: lead (N = 40), solvent (N = 39), lead/ solvent (N = 45), and control (N = 33). All subjects completed tests to assess concentration, motor skills, memory, and mood. Results: Relative to controls, the lead, solvent, and lead/solvent groups performed significantly more poorly on a test of verbal memory, while the lead and lead/solvent groups were slower than the solvent and control groups on a task of processing speed. Bone lead was a significant predictor of information processing speed and latency of response while solvent exposure was a significant predictor of verbal learning and memory. Conclusions: Bone lead was associated with slower speed of processing while exposure to lead and/or solvents reduced efficiency of verbal learning.

Fletcher, A. M., et al. (2006). "Characteristics of patients with work-related asthma seen in the New York State Occupational Health Clinics." J Occup Environ Med 48(11): 1203-1211.

OBJECTIVE: The objective of this study was to characterize the work-related asthma population seen by the New York State Occupational Health Clinic Network (OHCN) to determine which industries, occupations, and causal agents are associated with work-related asthma in New York State (NYS). METHODS: The OHCN patient database was analyzed to identify those patients with a diagnosis of work-related asthma and medical charts were then abstracted for data on demographics, clinical history, disease severity, industry, occupation, and putative agent. RESULTS: The OHCN patients with work-related asthma were most commonly employed in the service and manufacturing industries. Common occupations included teachers, farm operators/managers, and construction trades. The most frequently reported putative agents associated with work-related asthma were dust, indoor air, mold, and solvents. CONCLUSIONS: Our findings suggest the potential importance of prevention of workplace exposure in reducing adult asthma in NYS.

Jin, C. F., et al. (2004). "Industrial solvents and psychological effects." Clin Occup Environ Med 4(4): 597-620, v.

Organic solvents are widely used in industries for cleaning, degreasing, and other processes. The high dose neurotoxicity of occupational solvents is evident, and the existence of residual effects following lower dose exposure remains a focus of interest 30 years after initial reports of behavioral changes in painters from the Scandinavian literature. This article reviews recent studies on occupational solvent exposure and neuropsychological outcomes. The methodologic difficulties facing studies and the role of neuroimaging in solvent neurotoxicity investigations are examined. Existing studies consistently demonstrate association between exposure and neurobehavioral outcomes, but the specificity of the findings is less impressive. Threshold levels are uncertain. A safe and achievable threshold level seems possible from the current literature; unfortunately, such exposure limits have not yet been established by current studies. Several frequently encountered chemicals are discussed.

Luderer, U., et al. (2004). "Effects of occupational solvent exposure on reproductive hormone concentrations and fecundability in men." Am J Ind Med 46(6): 614-626.

BACKGROUND: Little is known about the effects of organic solvents on male reproductive health. To assess fertility and reproductive endocrine function in solvent-exposed men, we investigated time-to-pregnancy using a retrospective cohort design and cross-sectionally measured reproductive hormone concentrations in painters and millwrights compared to a reference group of carpenters. METHODS: Detailed occupational, exposure, medical, and time-to-pregnancy histories were obtained by telephone interview. Plasma luteinizing hormone (LH), follicle-stimulating hormone (FSH), and testosterone concentrations were determined by immunoassay. Exposure indices, which summarized working life exposure to total solvents, chlorinated solvents, aromatic solvents, and thinners, degreasers, varnishes, and adhesives as a category were calculated from exposure histories. RESULTS: FSH concentrations increased significantly with increasing exposure indices for all solvents and for chlorinated solvents. There were no significant associations of solvent exposure indices with LH or testosterone levels. LH, FSH, and testosterone concentrations also did not differ by job title. Using Cox regression, time-to-pregnancy was non-significantly longer in the painters and millwrights than the carpenters. There was no significant association between time-to-pregnancy and any of the solvent exposure indices; however, it should be noted that some of the pregnancies occurred more than 20 years previously, potentially reducing the reliability of the retrospectively collected pregnancy and exposure data. CONCLUSIONS: The significant associations between FSH levels and solvent exposure indices suggest the potential for adverse effects of solvent exposures on reproductive function in men.

Marraffa, J. M., et al. (2008). "Diethylene glycol: widely used solvent presents serious poisoning potential." J Emerg Med 35(4): 401-406.

OBJECTIVE: To describe the serious toxicity of a readily available solvent, diethylene glycol (DEG). We describe a case of intentional ingestion of a wallpaper stripper containing DEG resulting in severe multi-system organ failure. CASE REPORT: A 27-year-old male presented to the Emergency Department (ED) one day after ingesting wallpaper stripper containing DEG. He developed acidosis, renal cortical necrosis, hepatocellular injury, and severe neurologic sequelae, including cranial neuropathies and peripheral demyelinating sensori-motor polyneuropathy. His neurologic function improved over 5 months. DISCUSSION: Our case demonstrates the severe toxicity of DEG. DEG is present in numerous formulations, often without proper protective packaging. DEG has been associated with severe epidemic poisonings in the past and with the availability of safer alternatives, DEG in consumer products should be eliminated. CONCLUSION: DEG is found in numerous products. Delays in treatment can have devastating results, resulting in death or permanent disability. The pervasive use of this compound makes further human exposures likely.

Methner, M. M. (2000). "Identification of potential hazards associated with new residential construction." Appl Occup Environ Hyg 15(2): 189-192.

There were several advantages and limitations of this observational study. The most important advantage of this study was the opportunity to observe residential construction workers performing their jobs. By observing work practices, valuable information was gathered about specific trades and their potential exposure to various chemical and physical agents. This information will be useful in guiding subsequent exposure assessments. Probably the greatest limitation of this study was the lack of participation by homebuilders. Ideally, observations of construction processes would have been more objective if the study included the participation of more than one homebuilder. Aside from one worker who was observed to wear safety glasses, leather gloves, and a dust mask, virtually no personal protective equipment (PPE) was observed onsite. Often small contractors do not have the financial resources necessary to procure the appropriate PPE and issue these items to the workers. Based on hazard prevalence, professional judgement, and the degree of hazardous product use, potential exposures that warrant quantitative sampling efforts during Phase 2 of this study are: bulldozer/backhoe operators--noise, vibration, diesel exhaust; concrete workers--naphtha, mineral spirits, Portland cement; asphalt workers--petroleum hydrocarbons, asphalt, mineral spirits; plumbers--methylethyl ketone, acetone, tetrahydrofuran, cyclohexanone; drywall finishers--total and respirable dust, hexane, acetone; painters--ethylene glycol, VOCs; masons--dust (during the preparation of mortar); floor preparation technicians--total and respirable dust; and ceramic tile installers--toluene, naphtha, silica (from grout powder).

O'Cleireachain, M. R., et al. (2014). "The blue man: burn from muriatic acid combined with chlorinated paint in an adult pool construction worker." J Burn Care Res 35(4): e269-272.

Muriatic acid (hydrochloric acid), a common cleaning and resurfacing agent for concrete pools, can cause significant burn injuries. When coating a pool with chlorinated rubber-based paint, the pool surface is initially cleansed using 31.45% muriatic acid. Here we report a 50-year-old Hispanic male pool worker who, during the process of a pool resurfacing, experienced significant contact exposure to a combination of muriatic acid and blue chlorinated rubber-based paint. Confounding the clinical situation was the inability to efficiently remove the chemical secondary to the rubber-based nature of the paint. Additionally, vigorous attempts were made to remove the rubber paint using a variety of agents, including bacitracin, chlorhexidine soap, GOOP adhesive, and Johnson's baby oil. Resultant injuries were devastating fourth-degree burns requiring an immediate operative excision and amputation. Despite aggressive operative intervention and resuscitation, he continued to have severe

metabolic derangements and ultimately succumbed to his injuries. We present our attempts at debridement and the system in place to manage patients with complex chemical burns.

Qian, H., et al. (2010). "Occupational exposure to organic solvents during bridge painting." Ann Occup Hyg 54(4): 417-426.

Exposure to volatile organic compounds (VOCs) from bridge painting was measured in New York City and New Jersey during the summer and fall seasons from 2005 to 2007. The effect of painting activities (paint coating layer, confinement setup, and application method) and meteorological conditions (temperature, humidity, and wind speed) on solvent exposure to aromatic, ketone, ester, and alkane compounds were individually evaluated. Mixed-effect models were used to examine the combination effects of these factors on the air concentration of total VOCs as the individual compound groups were not present in all samples. Air concentration associated with spraying was not affected by meteorological conditions since spraying was done in a confined space, thus reducing their impact on solvent air concentration. The mixed models for brushing and rolling samples included two fixed factors, i.e. application method and temperature, and one random factor, i.e. sampling day. An independent dataset (daily air samples) was used to validate the mixed model constructed for brushing and rolling samples. The regression line of the predicted values and actual measurements had a slope of 1.32 +/- 0.15 for daily brushing and rolling samples, with almost all points being within the 95% confidence bands. The constructed model provides practical approaches for estimating the solvent exposure from brushing and rolling activities among construction painters. An adjusted mean air concentration derived from the activity-specific spray samples was the best estimate for that painting application.

Tang, C. Y., et al. (2011). "Occupational solvent exposure and brain function: an fMRI study." Environ Health Perspect 119(7): 908-913.

BACKGROUND: Deficits in cognitive function have been demonstrated among workers chronically exposed to solvents, but the neural basis for these deficits has not been shown. OBJECTIVES: We used functional magnetic resonance imaging (fMRI) to compare pathophysiological changes in brain function between solvent-exposed and control workers. METHODS: Painters, drywall tapers, and carpenters were recruited from the International Union of Painters and Allied Trades, District Council 9 in New York City and District Council 21 in Philadelphia, Pennsylvania, and from the Carpenters Union in New Jersey. Twenty-seven solvent-exposed and 27 control subjects of similar age, education, and occupational status completed the N-Back working memory test during fMRI. After controlling for confounders (age; lifetime marijuana, cocaine, and alcohol use; blood lead; symptoms of depression; verbal intelligence), voxelwise group analysis and regional activation levels were compared and then correlated with an index of lifetime solvent exposure. RESULTS: Solvent-exposed workers' performance on the N-Back was significantly worse than that of controls. Activation of the anterior cingulate, prefrontal, and parietal cortices--areas serving working memory function and attention--was also significantly lower for solvent-exposed workers relative to controls. After controlling for confounders, we observed a negative correlation between lifetime solvent exposure and activation in these same regions among the solvent-exposed workers. CONCLUSIONS: This study is one of the few to document neural structures affected by exposure to solvents. Our findings provide a biological mechanism for the neurobehavioral deficits in working memory and attention that have previously been reported by other groups studying the effects of chronic exposure to solvents. These imaging markers, which are consistent with the neurobehavioral measures in our subject population, are consistent with altered brain pathology caused by prolonged exposure to solvent mixtures during construction work.

Tran, J. Q., et al. (2012). "Transport of a solvent mixture across two glove materials when applied in a paint matrix." Arch Environ Contam Toxicol 63(1): 169-176.

The transport of mixed paint solvents through natural rubber latex (4 mil) and nitrile rubber (5 mil) gloves was evaluated after spray application of the paint formulation directly on the glove surface. Glove materials and thicknesses were those selected by the majority of spray painters in the local automobile repair industry. A flat panel containing glove specimens mounted in multiple permeation cells permitted evaporation of solvents from the applied paint and incorporated a solid sorbent receiving medium for measuring glove membrane transport. The panel was sprayed in a paint booth to simulate use conditions. Charcoal cloth under the glove adsorbed transported solvents, which were quantified by gas chromatography. For each solvent component, results were expressed as mass transported through the glove relative to the mass applied, per unit area, during 30 min after spray application. The paint formulation contained ketones, acetates, and aromatics. Natural rubber latex allowed 6-10 times the transport of solvents relative to nitrile rubber for all eight solvent components: methyl ethyl ketone, toluene, styrene, ethyl benzene, xylene isomers, and 2-heptanone. m-Xylene showed the largest difference in transport between the two glove materials. This solvent also had the highest transport for each material. The results indicate that nitrile rubber gloves offer somewhat greater chemical resistance to all eight solvents studied compared with natural rubber latex gloves, regardless of the chemical properties of the individual solvent components. However, it must be emphasized that neither of the glove materials, in the thicknesses used in this study, provide adequate protection when exposed by direct spray painting. Simulation of realistic spray conditions may offer a source of useful information on the performance of chemical protective gloves because it accounts for solvent evaporation and the effect of paint polymerization after application on glove transport.

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