

mg/m³±7) compared to demographically and socioeconomically-matched reference (R) workers in a food processing plant (n=60; 30 females and 30 males). Urinary phenol (UPh; µg/g creatinine), a marker of exposure, was significantly (p<0.01) higher in BZ than in R (65±2 and 8±1, respectively). More than 50% of BZ had IgG and IgM AuAb titers (ng/ml) to NF68, NF160 and NF200 compared to 13% of R (Z=3.2; p≤0.01). Mean titer levels were significantly (p≤0.01) higher in the BZ population. There was no statistical difference in either immunoglobulin to GFAP, although a higher percentage of BZ had titers. IgG to MBP were significantly (p≤0.01) higher in BZ than in R. A comparison based on gender also indicated a significant difference based on exposure. A comparison between exposed females and males indicated differences in only IgM to NF 160 and GFAP. These findings suggest that the neurotoxicity of chronic exposure to benzene warrants further study and that AuAb detection may be used in monitoring potential neurotoxic effects.

1987 EFFECTS OF VISUAL CONTRAST SENSITIVITY IN WORKERS EXPOSED TO STYRENE.

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Several studies have shown that styrene has ophthalmotoxic properties. Visual contrast sensitivity (CS) loss has been observed among workers exposed to organic solvent mixtures and styrene. Little attention has been paid to the relation between biological exposure index and CS loss. The present study aimed to (1) assess the relationship between urinary metabolites and CS loss and (2) examine visual function in relation to cumulative styrene exposure. CS was measured for 165 male workers exposed to styrene in four fiberglass and reinforced plastics factories (length of exposure>3 years) and 125 male non-exposed workers and college students using the Vistech MCT 8000 chart. All subjects were asked to complete questionnaire in which the items concerned their work history, occupational exposure or non-occupational solvent exposure, lifestyle habits, drug use and anamnesis. The personal styrene exposure in the air and end shift urinary mandelic acid (MA) and phenylglyoxylic acid (PGA) were measured, and the individual cumulative exposure index (CEI) was calculated. The results showed a significant reduction in CS at in styrene-exposed workers compared to the controls (p<0.001), after adjusting age, alcohol and smoking consumption. There was a significant effect of urinary MA+PGA level, with workers in high and medium concentration (>=200mg/g creatinine) group compared to low concentration group and controls at different spatial frequencies. With respect to CEI, there was a significant reduction in CS in 12 cycles per degree in high group workers than those in low group. The results suggest that urinary MA plus PGA less than 400 mg/g creatinine in long term exposure to styrene might lead to CS loss and CS loss might appear with increase of CEI.

1988 EXPOSURE-RESPONSE ANALYSIS FOR BERYLLIUM SENSITIZATION AND CHRONIC BERYLLIUM DISEASE AMONG WORKERS IN A BERYLLIUM METAL MACHINING PLANT.

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The current Occupational Exposure Limit (OEL) for beryllium has been in place for more than 50 years and was believed to be protective against chronic beryllium disease (CBD) until studies in the 1990s identified beryllium sensitization (BeS) and subclinical CBD in the absence of physical symptoms. Inconsistent sampling and exposure assessment methodologies have often prevented the characterization of a clear exposure-response relationship for BeS and CBD. Industrial hygiene (3,831 personal lapel and 616 general area samples) and health surveillance data from a beryllium machining facility provided an opportunity to reconstruct worker exposures prior to the ascertainment of BeS or the diagnosis of CBD. Airborne beryllium concentrations for different job titles were evaluated, historical trends of beryllium levels were compared for pre- and post-engineering control measures, and mean and upper bound exposure estimates were developed for workers identified as beryllium sensitized or diagnosed with subclinical or clinical CBD. Four methods were used to reconstruct historical exposures of each worker: industrial hygiene data were pooled by year, job title, era of engineering controls, and the complete work history (life-time weighted average) prior to diagnosis. Results showed that exposure metrics based on shorter averaging times (i.e., year versus complete work history) better represented the upper bound worker exposures which could have contributed to the development of BeS or CBD. It was observed that all beryllium sensitized and CBD workers were likely exposed to beryllium concentrations greater than 0.2 µg/m³ (95th percentile) and 90% were exposed to concentrations greater than 0.4 µg/m³ (95th percentile) within a given year of their work history.

Based on this analysis, it would appear that BeS and CBD generally occurred as a result of exposures greater than 0.4 µg/m³ and that maintaining exposures below 0.2 µg/m³ 95% of the time may prevent BeS and CBD in the workplace.

1989 PHARMACOKINETIC MODEL FOR ASSESSMENT OF LEUKEMIA RISK ASSOCIATED WITH DERMAL EXPOSURE TO CYCLOPHOSPHAMIDE AMONG NURSES.

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Cyclophosphamide (CP) is a human carcinogen. Oncology nurses are exposed to CP during daily work. This study aimed at assessing the leukemia risk of occupational exposure to CP in nurses.

Task-based dermal exposure intensities for oncology nurses were used to calculate dermal exposure levels to CP. Also, a worst-case exposure scenario was made using the maximum frequency for each task and the maximum intensity of exposure. Internal CP doses were estimated applying a PBPK model to assess the delivered dose for CP and its active metabolites, phosphoramidate mustard and acrolein, in bone marrow. This dose was related to epidemiological information from a longitudinal study with CP-treated patients using linear extrapolation from high to low dose to estimate the risk of leukemia for oncology nurses after 40 y occupational exposure to CP.

The cumulative phosphoramidate mustard and acrolein amounts in bone marrow were simulated to be 12.3 nmol for an average oncology nurse after 40 y occupational dermal exposure. The worst-case scenario with maximum task frequencies resulted in cumulative amounts of metabolites in bone marrow of 1.83 µmol.

Epidemiological data from a cohort of 111 ovarian cancer patients with a total CP dose of 46.35 grams over a 12 m period showed a cumulative risk for leukemia of 11.1% after a ten year period. This administered dose was inserted into the PBPK model as a monthly administration of 14.78 mmol CP into the blood compartment, which resulted in a cumulative dose of CP active metabolites in bone marrow of 5.02 mmol, after 12 m.

Based on this model the risk of developing leukemia for nurses exposed to CP via the skin of hands for 40 y, was estimated to be 0.3 per million oncology nurses. This risk estimate could potentially increase to a maximum of 40 per million oncology nurses for nurses with the maximum exposure frequency and intensity for all tasks (worst-case scenario).

1990 EPIDEMIOLOGICAL INVESTIGATION OF CANCER RATES WITHIN A TWO MILE RADIUS OF VERMICULITE ORE PROCESSING SITES IN UTAH.

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Vermiculite ore from Libby, Montana contained high levels of amphibole asbestos and asbestiform fibers and has been associated with asbestos related disease among Libby residents. Human exposure to the contaminated vermiculite has possibly occurred in communities throughout the United States located near facilities that received vermiculite ore from the Libby mine. A major source of exposure to asbestos is from exfoliation of the ore at exfoliation facilities. The U.S.E.P.A. identified two former exfoliation facilities in Salt Lake City, Utah, which operated from 1941-1987.

The Utah Department of Health investigated the incidence of asbestos-related cancers and asbestos related mortality in a two-mile radius around these sites for the following time periods: 1973-79, 1980-85, 1986-90, 1991-95, and 1996-2000. Cancer data were obtained from the Utah Cancer Registry. Mortality data were obtained from the Office of Vital Records for the same population group.

Cancer incidence and mortality rates in the two-mile radius study area for all asbestos-related cancers combined, cancer of the respiratory system and intrathoracic organs, and cancer of the lung and bronchus were significantly elevated during the time periods analyzed.

Rates for mesothelioma and asbestosis, diseases directly related to asbestos exposure, were not elevated in the study area. This suggests that exposure from the vermiculite processing facilities likely were not a significant contributing factor to the increased rates observed in other asbestos related cancers and diseases in the study area.

Factors that must be considered in the development and etiology of cancers, but that could not be evaluated in this investigation, include latency period, population migration, personal habits, diet, occupational exposures, and familial history of cancer. These issues limit the conclusions that can be drawn from this investigation. Additional research is needed to address the impact of these risk factors on the elevated rates of respiratory cancers in the study area.