

risk factors for agricultural-related injuries to children. Participants were contacted every six months to identify injuries (cases) in the previous six-month periods of 2001. All cases, <19 years of age and controls (~4:1), (identified through an algorithm encoded into the CATI system), were interviewed to obtain relevant exposure data. The analyses, both univariate and multivariate (based on a directed-acyclic-graph causal model), will be compared to those from the 1999 RRIS-II baseline effort.

Results. Preliminary analyses of 1999 data found boys at increased risk of injury (O.R., 1.9; 95% C.I., 1.4-2.6), compared with girls, and varying risk with age (0-4 years, reference): 5-9 (1.6; 0.8-3.0); 10-14 (3.0; 1.7-5.5); 15-19 (2.2; 1.2-4.0). However, rates per 100,000 working hours were slightly lower for boys (6.3) than girls (7.9); rates by age group demonstrated a reverse trend: 5-9 (11.7); 10-14 (7.5); 15-19 (4.7). Animals were the modal source of injury (40%). Univariate analyses indicated increased risks for working with beef (O.R., 2.4; 95% C.I., 1.7-3.3), dairy (1.8; 1.2-2.7), swine (1.9; 1.2-3.1), machinery (2.0; 1.4-2.9), operating tractors (2.1; 1.5-2.9), and riding on tractors (2.2; 1.6-3.0). Initial multivariate analysis of animal-related injuries, controlling for age, gender and hours worked, found increased risks for exposures to beef cattle (2.0; 1.4-2.8) and horses (2.5; 1.7-3.7).

Conclusions. Ongoing surveillance to identify incidence and consequences of injury, as well as risk factors, will provide sound scientific data for the development of focused intervention strategies and pertinent evaluation that cannot be accomplished through traditional surveillance efforts. This is essential to reduce morbidity and mortality from injuries in the agricultural community.

121 Industries in which workers are at risk for beryllium exposure
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Background. Most epidemiologic research on beryllium-related health problems has focused on the primary industry or the large users of this metal in atomic energy and weaponry. The findings from these studies suggest that exposure to relatively low levels of beryllium can lead to sensitization and the development of chronic beryllium disease in the lungs. Therefore, it is important to identify companies outside the primary industry and atomic industry where beryllium exposure occurs. Existing data were used to identify such companies in the United States.

Methods. We relied on two sources of industrial hygiene sampling results. First, we used exposure measurements from work-site inspections completed between 1979 and 1996 by the Occupational Safety and Health Administration (OSHA). OSHA maintains these data in the Integrated Management Information System (IMIS). Second, the National Institute for Occupational Safety and Health (NIOSH) conducts work-site investigations in response to requests from the public as part of the Health Hazard Evaluation (HHE) program. We reviewed the results stored in the IMIS data base and HHE records to determine in which four-digit Standard Industrial Classification (SIC) categories beryllium had been detected at or above 0.1 µg/m³. This level was considered to be a reliable lower limit of detection above background noise and interference in the method of analysis.

Results. A total of 111 four-digit SIC codes were identified as having at least one beryllium measurement at or above 0.1 µg/m³, and approximately three-quarters of these industry categories were in the manufacturing sector. However, companies were also identified in many other sectors, including mining, construction, transportation and public utilities, wholesale trade, services, and public administration. Approximately a third of the four-digit SIC codes with beryllium exposure had two or more samples at or above the NIOSH recommended exposure limit of 0.5 µg/m³, and all of these higher measurements were in the manufacturing, construction, and mining sectors.

Conclusions. Neither the IMIS nor HHE data set represents a random sample of all industries in the United States, and inspections were not conducted by OSHA or NIOSH with the intention of identifying all

worksites where beryllium was used. Nevertheless, these findings suggest that exposure to beryllium can occur in secondary and tertiary industries, and additional work is needed to address this problem.

122 Surveillance methods for solvent-related hepatotoxicity
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Background. The objective of this investigation was to determine the efficacy of routinely available biochemical tests of hepatic function in relation to ultrasonographic methods for detecting evidence of early hepatic injury in workers exposed to mixed hydrocarbon solvents.

Methods. A cross-sectional investigation of 102 workers with a range of cumulative career exposures to organic solvents, including carpenters (low exposure), millwrights (intermediate exposure), and industrial painters (high exposure) was conducted. Data collection included an interview-administered questionnaire used to determine a semi-quantitative cumulative exposure index to mixed hydrocarbon solvents, obtained simultaneously with a venous sample collection for hepatic biochemical tests (alanine aminotransferase [ALT], aspartate aminotransferase [AST], alkaline phosphatase [AP], gamma-glutamyl transpeptidase [GGT], direct/total bilirubin), and hepatic ultrasonography. Sonograms were interpreted as normal, mild, or moderate to severe parenchymal change by three radiologists blinded to exposure status. Multiple linear regression analyses were used to assess hepatic biochemical levels (IU/L) and ultrasonographic parenchymal changes, respectively, as a function of cumulative exposure to mixed organic solvents (both by work type and semi-quantitative index), adjusting for the confounding variables of age, gender, alcohol intake, body mass index, and serologic evidence of prior Hepatitis B/C infection.

Results. A significant increase in the hepatic cholestatic enzyme gamma glutamyl transpeptidase (GGT) was observed in painters, with a mean level of 41 IU/L, compared with carpenters and millwrights (27 IU/L; p<0.05). A significant exposure-response relationship for GGT and semi-quantitative index to mixed solvents was observed in multivariate analyses controlling for age, gender, alcohol, body mass index, and evidence of prior Hepatitis B/C (p<0.05). Along with changes in GGT, a concomitant trend towards increased sonographic parenchymal changes in relation to mixed solvent exposure (p=0.07) was also observed. No significant changes or trends were observed for AST, ALT, AP, or bilirubin in relation to solvent exposure.

Conclusions. The significant exposure-response relationship between gamma glutamyl transpeptidase (GGT) levels and cumulative exposure to mixed organic solvents supports a primary cholestatic effect of hydrocarbon mixtures, providing a useful biomarker of effect among exposed workers. The efficacy of GGT in surveillance of workers exposed to mixed organic solvent compounds is further supported by the consistent trend in sonographic hepatic parenchymal changes observed in relation to solvent exposure in this investigation.

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123 The mortality and cancer morbidity experience of female workers at the Sellafield plant of British Nuclear Fuels plc, 1948-1998
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Background and methods. We present the preliminary results of the analysis of the BNFL Sellafield cohort of female workers. We report on the mortality and morbidity experience of these 6,346 employees to the end of 1998. These workers have accumulated 142,337 person-

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