10083-Prostate Cancer Risk In the Agricultural Health Study Cohort

Alavanja, MCR[1], Samanic, C[1], Dosemeci, M[1],
Tarone, R[1], Lynch , C[2], Lubin, J[1], Thomas, K[3], Hoppin, J[4], Coble, J[1], Sandler, D[4], Blair, A[1]
[1]National Cancer Institue , [2]University of Iowa, [3]US EPA , [4]NIEHS

Our knowledge of the etiology of prostate cancer is still quite limited. We examined the relationship between 50 important agricultural pesticides and prostate cancer incidence in a prospective cohort study of 55,332 male private and commercial applicators with no prior history of prostate cancer. Methods: Data were collected for the Agricultural Health Study by means of a self-administered questionnaires completed at enrollment into the study (1993-1997). Cancer incidence was determined through state population-based cancer registries from enrollment through December 31,1999. A prostate cancer standardized incidence ratio (SIR) was computed for the cohort using standard methods. Odds ratios were computed for individual pesticides and for pesticide usage patterns identified by means of factor analysis. Results: The prostate cancer SIR, 1.14 (95% CI, 1.05-1.24), was significantly elevated for the AHS cohort compared to the male populations of Iowa and North Carolina. Factor analysis identified a pesticide usage pattern characterized by pesticide applicators over 50 years of age and chlorinated pesticides, which was significantly associated with prostate cancer risk. Methyl bromide, a widely used halogenated fumigant, was also associated with an excess risk. Several other pesticides showed a significantly increased risk of prostate cancer among study subjects with a family history of prostate cancer but not among those with no family history. Conclusion: Methyl bromide was significantly associated with an excess risk of prostate cancer, as was a pesticide usage pattern characterized by pesticide applicators over 50 years of age and chlorinated pesticides. Elevated risks of prostate cancer among pesticide applicators with a family history of prostate cancer suggests familial susceptibility.

10088-Cross sectional study of DDT and its metabolite levels in Breast milk from Saudi mothers

Iman Al-Saleh[a], Mohammed Al-Zahrani[b], Mohamed Al-Shanshoury[b], Neptune Shinwari[a], Patrick Basile[a], Inaam Al-Doush[a], Gamal El Din Mohammed[c]

[a] *Biological & Medical Research Department, King Faisal Specialist Hospital & Research Centre, P.O.Box: 3354, Riyadh, Saudi Arabia;* [b] *Department of Preventive Medicine, Ministry of Health, P.O.Box: 2903, Riyadh 11461, Saudi Arabia;* [c]*Biostatistics, Epidemiology & Scientific Computing Department, King Faisal Specialist Hospital & Research Centre, P.O.Box: 3354, Riyadh, Saudi Arabia.*

A cross sectional study was designed to measure DDT residues and its metabolites in breast milk samples collected randomly from Saudi lactating mothers living in Al-Ehssa region; which was under leishmania control until 1995, and compare them to samples from mothers living in Riyadh region where no spraying activities took place. *p,p*-DDE, *p,p*-DDD and *p,p*-DDT residues were measured in 878 breast milk samples by Gas Chromatography/Electron Capture Detector (GC/ECD) and confirmed by Gas Chromatography/Mass Spectrometer Detector (GC/MSD). The arithmetic mean *p,p*-DDE, *p,p*-DDD, *p,p*-DDT and ∑*p,p*-DDT levels for lactating mothers were 0.632 $\pm$ 1.529 μg/g Fat (range 0 to 24.488 μg/g Fat), 0.041 $\pm$ 0.344 μg/g Fat (range 0 to 9.752 μg/g Fat), 0.183 $\pm$ 1.159 μg/g Fat (range 0 to 32.038 μg/g Fat) and 0.856 $\pm$ 2.637 μg/g Fat (range 0 to 57.078 μg/g Fat) respectively. Variations in the DDT levels were investigated with respect to regional distribution after adjusting for a number of risk factors. Lactating mothers from Al-Ehssa region had significantly higher ∑*p,p*-DDT concentrations ($p<0.05$) than lactating mothers living in Riyadh region. The implications of the spraying activities in Al-Ehssa region are obvious. We estimated that 88.3% of infants of lactating mothers living in Al-Ehssa region had ∑*p,p*-DDT daily intakes that exceeded 20 μg/Kg-day of body weight, the WHO/UNEP Acceptable Daily Intakes for a 5-Kg infant. Exposure of lactating mothers to these chemicals poses a serious health problem for infants. Regular monitoring of these chemicals should continue until concentrations fall within the acceptable daily intake.
It was surprising to find that the frequency of ∑*p,p*-DDT in Riyadh region is almost as high as in Al-Ehssa (98.5% compared to 99.8%) as indicated in the Table below.

Table. Frequency (%) of positive of *p,p*-DDE, *p,p*-DDD and *p,p*-DDT in breast milk samples of lactating mothers (n=878).

Residue	**All**	**Riyadh region**	**Al-Ehssa region**
***p,p*-DDE**	99.2%	98.5%	99.8%
***p,p*-DDD**	37.1%	26.2%	45.9%
***p,p*-DDT**	73.7%	69.7%	76.8%

Apart from dietary sources, there is no obvious explanation for this specific finding taking into consideration that the use of these pesticides for agriculture purposes was banned by the Government since 1982. Further investigation is urgently needed to determine the sources of exposure especially in foodstuffs of animal origin such as dairy and meat products.

10247-Home Levels of Pesticide Residues, Agricultural Drift and Self-Reported After-work Hygiene Practices

McCauley, LA[1], Muniz, J[1], Rothlein, J[1], Michaels, S[1], Lasarev, M[1], Ebbert, C[2]
[1]Oregon Health & Science University , [2]Oregon State University

Little is known about the relationship between levels of pesticides in homes and the amount attributable to drift from agricultural applications and take home exposure from agricultural workers. We conducted an investigation of 24 agricultural families owning or operating fruit orchards to characterize the organophosphate pesticide levels in house dust and the relationship between dust residue levels, self-reported afterwork hygiene practices and home characteristics. The homes of 4 control families were also sampled. Control families had no members working in agriculture and lived more than a mile away from an active orchard. Azinphos-methyl was the most frequently detected organophosphate, found in 19 of 24 home play areas (median = 0.71ppm). Other organophosphates detected included chlorpyrifos (median 0.14ppm), phosmet (median 0.38ppm), and malathion (median 0.15ppm). A total sum of all organophosphate residues detected was also calculated (median 1.06ppm). In entryways azinphos-methyl was again the most frequently found pesticide, and at levels higher than in the play areas in most homes. Levels in uncarpeted areas were noticeably lower than residue levels from carpets. No organophosphate pesticide residues were detected in the four control homes. Residue levels were significantly associated with the number of people in the home whose work included mixing/applying pesticides or tree thinning ($p < 0.01$). A significant association was found between levels of organophosphate residue and the reported number of days since cleaning in the area where the sample was taken ($p = 0.03$). Mean levels of total organophosphate pesticides increased approximately 1.2 ppm for each additional week since the last reported vacuuming (95% CI: 0.1 to 2.2 ppm). Mean levels of organophosphate pesticides were higher in the homes of male workers who reported they wait more than two hours before changing out of their work clothes compared to homes where the worker changes within two hours after returning from work ($p < 0.01$). No significant associations were found between residue levels and home characteristics (age, size, and distance from the orchard), however there was a trend for levels to decrease with increasing time since the last agricultural organophosphate application. The results of this study provide evidence that pesticide residues in household dust are deposited both by afterwork hygiene practices and drift from close-by agricultural fields treated with chemicals. Workers can inadvertently carry agricultural chemicals from their work into their homes and thereby increase the risk of exposure of other family members to these substances inside the home.

10270-Residential Pesticide Exposures and Risk of Parkinson's Disease

JA Firestone[1,3], GM Franklin[1,3], WT Longstreth, Jr.[2,3], T Smith-Weller[1], PD Swanson[3], H Checkoway[1,2]

[1]Department of Environmental Health , [2]Department of Epidemiology , [3]Department of Neurology; University of Washington, Seattle, WA, USA.

Pesticide exposures have been associated with increased risk of Parkinson's disease (PD). Risk estimates reported for residential pesticide exposures have been inconsistent, perhaps because exposure assessment has often relied on surrogate measures such as those related to rural living, residential locale, or source of drinking water. The resulting misclassification of exposures can mask associations. We present findings from a population-based, case-control study designed to estimate the relative risk of incident PD from residential pesticide exposures assessed in multiple ways. Cases (n=220) and controls (n=352) were recruited from western Washington state enrollees of the Group Health Cooperative HMO. Exposure data were obtained by subjects' self-report, in face-to-face interviews, using a structured questionnaire. Along with demographic information and smoking history, subjects identified specific brand-name products and general pesticide use categories, and they provided life histories of residential locale and well water consumption. Conditional logistic regression controlled for the subjects' matching by age and gender, and for subjects' smoking status, yielding risk estimates in the form of adjusted odds ratios (OR) and 95% confidence intervals (95%CI). The ORs for all specific pesticides and general pesticide use categories show small effects, with 95%CIs including 1.0. Of note, the risk estimates suggest that all these exposures were protective (OR < 1.0). Conversely, surrogate indicators related to rural living suggest increased risk from "ever living on a farm" (OR=1.2; 95%CI=0.8-1.8), "residence on a farm for more than five years during childhood" (OR=1.6; 95%CI=1.0-2.4), and "well water consumption" (OR=1.3; 95%CI=0.9-2.0). While these findings are consistent with the growing body of literature linking residential pesticide exposures with Parkinson's disease, the risk estimates are modest and not statistically significant. Future work must focus on refining the measures of residential pesticide exposure to help reveal potentially meaningful associations.

10280-NON-RESIDENTIAL ORGANOPHOSPHORUS PESTICIDE USE AS A PREDICTOR OF CHILDREN'S URINARY METABOLITE LEVELS.

Julie A. Baker, Pauline Mendola, Dana Barr, Debra Walsh, John Creason, and Larry Needham. (University at Buffalo, US Environmental Protection Agency, and Centers for Disease Control and Prevention)

The role of pesticides in pediatric illness is not well understood. This pilot study evaluated the impact of non-residential organophosphate (OP) pesticide applications on children's urinary metabolite levels in a county with year-round agricultural activity. Children aged 2–4 years (n = 112) who presented at community pediatric clinics with flu-like symptoms suggesting unrecognized pesticide-related illness were evaluated for the presence of OP metabolites. Urinary dialkyl phosphate metabolites were measured. Only 2 children had levels below the limits of detection (LOD) and the range for total metabolite levels was from <LOD to 895 ppb (median = 19.1 ppb). Children's OP pesticide exposure was estimated based on the total pounds of OP active ingredient applied on the days surrounding illness and examination. County-wide total daily OP applications ranged from 1,327–12,570 pounds (mean = 6,402 pounds) and application of pesticides yielding ethyl metabolites exceeded those yielding methyl metabolites (respective means 5,648 and 698). Adjusting for body temperature and Spanish language, pesticide applications on the day before the onset of illness significantly predicted urinary metabolite levels (adjusted R^2=0.166; $p<0.05$). Pesticide application on the day before specimen collection was not associated. Imputing peak urinary metabolite levels at the onset of illness (based on an acute exposure model) increased the predictive value of the model (adjusted R^2 = 0.186; $p<0.05$). Similar patterns were noted when methyl and ethyl derivatives were examined separately. These findings suggest that pesticide exposure immediately preceding the current illness was consistently, modestly associated with preschool children's urinary metabolite levels, despite variable presentations and durations of illness.

10292-REGIONAL VARIATION IN THE INCIDENCE OF SYMPTOMATIC PESTICIDE EXPOSURES: APPLICATIONS OF GEOGRAPHIC INFORMATION SYSTEMS

Authors:
Daniel L. Sudakin,[1,2] Zane Horowitz,[2] Sandy Giffin[2]
[1]Oregon State University Department of Environmental and Molecular Toxicology, Corvallis, Oregon
[2]Oregon Poison Center, Department of Emergency Medicine, Oregon Health and Sciences University, Portland, Oregon

Objective: As United States poison control centers routinely collect spatial identifiers from callers, geographic information systems (GIS) may prove useful for a higher level of analysis of these data. Spatial and temporal analysis may prove particularly useful in the surveillance of sentinel events involving pesticide exposures. The purpose of this investigation is to evaluate the epidemiology of symptomatic human pesticide exposures using poison control center data and GIS, and to utilize a spatial scan statistic to investigate for temporal and spatial clusters. Methods: The Oregon Poison Center, a regional poison center with a wide geographic coverage area serving a population of over 3.4 million people, provided the data set for this investigation. All symptomatic human pesticide exposures reported to a poison control center during the year 2000 were included for analysis using Arc^{R}Info 8.1. Maps were generated displaying the location of incident cases, as well as crude incidence rates for each county. SaTScan v2.1 was utilized to generate a space-time scan statistic to evaluate for clustering of symptomatic human exposures. A total of 4999 Monte Carlo replications were conducted for statistical inference. Results: Of 1,347 pesticide exposures, 322 (24%) resulted in mild, moderate, or major outcomes. Most (86%) symptomatic cases involved residential exposures, and 14% percent of symptomatic cases involved children under the age of 5. Insecticides including organophosphates, pyrethrins and pyrethroids were associated with the largest proportion of symptomatic cases (66%). The records of 92% of symptomatic cases contained spatial identifiers (zip code, city, or county origin of caller) that could be further analyzed using GIS. While the number of incident cases was strongly associated with population counts by county ($r=.964$, $P<.001$), crude incidence rates of symptomatic exposures had no apparent relationship to county population and demonstrated wide geographic variation. A spatial and temporal cluster of symptomatic pesticide exposures was identified during the period from April 1- August 31, 2000, covering a large geographic area of eastern and predominantly rural regions of the state. The relative risk of reporting a symptomatic pesticide exposure among individuals within this geographic area was 1.809 (log likelihood ratio 18.5, $P= 0.0005$). Conclusions: GIS can be effectively utilized by poison control centers to study regional variation in the incidence of human pesticide exposures, and to identify spatial and temporal clusters. A need for further investigation to study why individuals in rural regions of the state are more likely to report a symptomatic pesticide exposure was demonstrated. With the collection of more accurate spatial identifiers and demographic data from callers to poison centers, GIS may have many additional applications in the surveillance and prevention of pesticide and other sentinel event exposures.

10341-Residential Proximity to Agricultural Pesticide Use and Incidence of Breast Cancer in the California Teachers Study Cohort

P. Reynolds[1], D. Goldberg[2], R. Gunier[1], A. Hertz[3], S. Hurley[2], A. Subotic[3], S. Yerabati[3], and the California Teachers Study Steering Committee ([1]California Department of Health Services, Oakland, CA; [2]Public Health Institute, Berkeley, CA; [3]Impact Assessment Inc., La Jolla, CA)

The objective of this study was to examine the association between residential proximity to agricultural pesticide use and the incidence of breast cancer among members of the California Teachers Study (CTS) cohort. Created in 1995-1996, the CTS cohort was established from the 133,479 respondents to a mailed questionnaire sent to all female professional school employees in the Statewide Teachers Retirement System. Residential address at the time of entry in the cohort was geocoded for 121,597 of the teachers (98.1%) and 1,648 cases of invasive breast cancer were prospectively identified among the geocoded CTS members for 1995-1999. California Pesticide Use Reporting (PUR) System data from 1993-1995 were used to determine chemicals, amounts and location of statewide agricultural pesticide applications**.** Pesticides were selected for analysis based on volume of use, carcinogenic potential and exposure potential. The pesticides were subsequently combined into six categories according to their toxicological properties. Five pesticides (simazine, diuron, oryzalin, propargite and methylbromide) were also analyzed individually, since these pesticides were identified as having the greatest potential to cause breast cancer. Residential pesticide exposure potential to CTS cohort members was determined using a Geographical Information System (GIS) to calculate total usage of pesticides, belonging to each category, applied within a half-mile radius surrounding each subject. Cox Proportional Hazards models were used to generate relative risk (RR) estimates for the pesticides of interest, adjusting for age, race and census block group measures of socioeconomic status. The referent category for these analyses was pesticide use density of less than 1 lb./square mile. Our analyses revealed no evidence that residential proximity to agricultural pesticide use was related to risk of breast cancer. The RR estimates for the highest quartile of exposure for Class B carcinogens was (1.07, 95% CI=0.82,1.39); Class C carcinogens (1.03, 95% CI=0.82,1.30); mammary carcinogens (0.95, 95% CI=0.70,1.30); endocrine disruptors (1.00, 95% CI=0.80,1.25); anticholinesterases (RR=1.10, 95% CI=0.88,1.37); organocholorides (1.03, 95% CI=0.61,1.75). There was no evidence for trend. Further adjusting the models for degree of urbanization did not substantially affect the risk estimates nor did stratifying by menopausal status and family history, although stratified analyses were hindered by small numbers. Potential for pesticide exposure in these analyses, however, were based on recent residential proximity (≤ 5 years prior to diagnosis) and may not be reflective of long-term exposure or early life exposures which may be of more etiologic relevance.

10406-PREVALENCE OF DETECTION OF HERBICIDES IN A SAMPLE OF RURAL RESIDENTS DURING SPRING HERBICIDE APPLICATION

Semchuk K.M. (1,2), McDuffie H.H.(2), Cessna A.J. (3), Senthilselvan A.(4), Irvine D.G. (5).
(1) College of Nursing, University of Saskatchewan, Saskatoon, SK, Canada; (2) Institute of Agricultural Rural and Environmental Health, University of Saskatchewan, Saskatoon, SK, Canada; (3) Agriculture and Agri-Food Canada, Lethbridge, AB, Canada, current address: National Water Research Institute, Environment Canada, Saskatoon, SK, Canada; (4) Department of Public Health Sciences, Faculty of Medicine, University of Alberta, Edmonton, AB, Canada; (5) Deceased, formerly with the Toxicology Group, University of Saskatchewan, Saskatoon, SK, Canada

Introduction: Residents of areas with intensive crop production may be exposed to herbicides through direct contact and environmental sources, particularly during the herbicide application season. Review of the empirical literature on herbicide exposures of humans revealed no estimates of the prevalence of detection of herbicides in rural populations.

Methods: As part of the interdisciplinary study of the Sustainability of the Semi-Arid Prairie Ecosystem (PECOS), we used gas chromatography/mass spectrometry analysis to measure blood plasma concentrations of eight common herbicides in a sample of rural residents (119 males, 102 females) of Saskatchewan, Canada during the spring herbicide application season (June/July) of 1996. Using self-reported data and logistic regression analysis, we identified factors associated with herbicide detection.

Results: Herbicide concentrations were detected in specimens from 74 participants (33.5%), including males (47.9%), females (16.7%), adults aged $ 18 years (34.0%), youths aged 12-17 years (29.2%), farm residents (38.0%), town residents (21.4%), herbicide applicators (68.5%), family members (spouse, son or daughter) of applicators (25.0%), and other non-applicators (11.6%). The prevalence of detection (limits of detection in ìg/L) of each target herbicide was: bromoxynil: 29.4% (2-50 ìg/L), 2,4-D: 10.9% (2-8 ìg/L), MCPA: 4.1% (2-5 ìg/L), dicamba: 0.9% (2-10 ìg/L), triallate: 0.5% (2-50 ìg/L), trifluralin: 0.5% (2-5 ìg/L), ethalfluralin: not detected (2-8 ìg/L), and fenoxaprop: not detected (3-10 ìg/L). The range in concentrations detected varied by herbicide; however, for each herbicide the median concentration was non-detectable. The crude odds ratio (OR) for herbicide detection was significantly increased for males (OR: 4.60, 95% confidence interval [CI]: 2.44-8.65), farm residents (OR: 2.25, 95% CI: 1.10-4.59), herbicide applicators (OR: 16.60, 95% CI: 7.47-36.92), and family members of applicators (OR: 2.55, 95% CI: 1.05-6.19). The odds ratio remained significantly increased for herbicide applicators (adjusted OR: 11.62, 95% CI: 4.69-28.81) and for family members of applicators (adjusted OR: 3.40, 95% CI: 1.21-9.54) after adjustment for gender and residence.

Conclusions: The high prevalence of detection of herbicides in specimens from herbicide applicators likely reflects recent occupational exposures due to field application. The herbicide concentrations detected in specimens from family members of herbicide applicators and from other non-applicators suggests that these rural residents were environmentally exposed. Further research is needed to understand the environmental herbicide exposures of rural populations and any potential human health effects.

10539-12th Conference of the International Society of Exposure Analysis (ISEA); August 11 – 15, 2002

PESTICIDE SESSION – ABSTRACT SUBMISSION

Title:

Calendar-Based Aggregate and Cumulative Risk Analyses of Pesticides: The Role of the Consumer Product Use Survey Data

Authors:

Vedula, U.[1], L. Recker[1], C. Lunchick[2], M. Pandian[3], J. Driver[3], and L. Jacobs[4]

[1]S. C. Johnson & Son, Inc.
[2]Aventis CropScience
[3]infoscientific.com, Inc.
[4]NFO WorldGroup

Abstract:

The Environmental Protection Agency (EPA) is responsible for regulating the sale and use of pesticides in the United States. To evaluate the potential aggregate and cumulative exposures and potential health risks associated with pesticide use as defined under the Food Quality Protection Act (FQPA) of 1996, and to evaluate potential ramifications of regulatory decisions related to the sale and use of pesticides, pesticide and pesticide product manufacturers, risk analysts and risk-benefit managers must have information about how, where, when, why and how much each pesticide is used in the United States.

Evaluation of potential aggregate and cumulative pesticide exposures in and around residences present unique challenges as a result of the complex and dynamic nature of this environment. Conceptually, potential exposures can occur as the result of the interaction (spatial and temporal) of product application or use and human activities in affected microenvironments. Residential exposure assessments to pesticides may involve more than one source (i.e., more than one product may be used in households that use pesticide products) and multiple pathways and routes. For example, a given pesticide active ingredient may be found in a product applied by a homeowner to control pests indoors, and for a certain fraction of U.S. households, the same ingredient may be found in another product applied by the same homeowner outside their home. In addition to possible exposure during the application of these products, homeowners may engage in certain post-application activities that may result in exposure opportunities by the inhalation, dermal and incidental ingestion routes. Thus, for some proportion of U.S. households, two or more product applications and/or potential post-application exposure time periods (i.e., when released environmental residues are present in/on media and available to contribute to exposure) may overlap or co-occur across time Determination of the potential co-occurrence of pesticide product use and potential exposures during a toxicologically relevant time period requires temporal product use information. Existing pesticide label information, market research data and product use surveys do not provide the complete compliment of use information, and only limited, if any temporal data needed to establish calendar-based profiles of product use and to estimate the likelihood of daily co-occurrence [e.g., use (application) of the same product on

multiple sites, multiple applications of the same product to the same site, use of multiple products containing the same pesticide on multiple sites, use of multiple products on multiple sites containing pesticides that are part of a "class" with a presumed common mode of action]. In addition, often these sources do not associate specific product use information with actual consumer user's demographic and geographic characteristics. This latter association is critical to support the development of scientifically credible and more realistic calendar-based exposure profiles for populations of individuals in households across the U.S.

The Residential Exposure Joint Venture (REJV) was formed under the auspices of the Consumer Specialty Products Association (CSPA) to address the evaluation of existing product use information sources, the development of more relevant data, and the information management and application of both existing and newly developed data for purposes of temporal ("calendar-based") aggregate and cumulative exposure modeling and assessment. The REJV's effort has direct applicability to models being developed such as CARES (Cumulative and Aggregate Risk Evaluation System), Calendex™, LifeLine™, and SHEDS (Stochastic Human Exposure and Dose Simulation model, for purposes of calendar-based, probabilistic risk analysis under the FQPA.

As part of its overall effort, the REJV has sponsored a national pesticide use survey (diary instrument) that addresses demographic, geographic, and temporal product use over a 12 month time period. This presentation provides an overview of the survey's purpose, design, implementation, and a discussion of the application of the data in calendar-based aggregate and cumulative assessments.

10585-Assessing the Spatial Accuracy of the California Pesticide Use Reporting Database for Use in Exposure Assessment Studies

RS Miller [1], JR Nuckols [1], R Gunier [2], A Hertz [2], P Reynolds [2]

[1] Colorado State University; [2] California Department of Health Services

Exposure to agricultural chemicals has been associated with disease outcomes such as cancer, immune system disorders, adverse reproductive outcomes, developmental disorders, and neurological disease. Pesticide use data that provides accurate location for where pesticides are applied is important for assessing relationships between health outcomes and pesticide exposure. The State of California has developed a Pesticide Use Reporting Database (CPUR), with the objective of providing complete agricultural pesticide use data for evaluating possible associations with health outcomes. Several recent epidemiological investigations have utilized the CPUR database. However, the spatial accuracy of the database has not been evaluated. The CPUR database was established in the 1950's with limited reporting and contains information on the pesticide type, pounds applied, date, method of application, acres of crop treated. Beginning in 1990, a full use reporting system was instituted requiring commercial growers to report all pesticides used in agriculture. The reporting unit for the database is Public Land Survey System Section, which is approximately 1 mi^2. We compared the CPUR pesticide application data by crop with high precision, 100% ground verified land-use data collected by the California Department of Water Resources (CDWR). CDWR identifies 83 specific crop types with a minimum mapping unit of 0.003 mi^2. We used a Geographic Information System (GIS), to conduct a comparative analysis of the location of pesticide application by crop, as reported in CPUR, with the location of the same crops in the CDWR database. We conducted the comparative analysis for ten crops with the greatest number of pesticide applications for two counties, San Joaquin (1988) and Kings (1991). To assess the accuracy of the CPUR data, we developed a GIS analytical procedure, which computed the spatial agreement between the two datasets. The comparative analysis was performed at the Section extent (N = 3,856). We tested the resulting congruence estimates for statistical significance using a one-sided binomial test for two levels of assumed crop location error in the CDWR database (1% and 5% error). Overall agreement between CPUR and CDWR was relatively high, although statistically significant differences existed between the datasets assuming 5% error in CDWR data. Accuracy assessment indicates large variation in CPUR reporting accuracy, ranging from 73.1% for cherries to 95.1% for cotton. In general, overall agreement was significantly higher in Kings County for 1991 than for San Joaquin County in 1988 for both non-permanent crops (92.9% vs 81.9% respectively) and semi-permanent crops (87.4% vs 80.7% respectively). These results indicate spatial and temporal differences in accuracy of the CPUR dataset, at both the aggregate and individual crop level. The spatial accuracy of pesticide-use data can affect exposure assessment, and may result in misclassification of exposure in epidemiological investigations.

10594-Tobacco Harvesters' Hand Exposure to Acephate and the Effectiveness of Hand Washing at Removing Acephate from the Hands.

Curwin, BC[1]; Sanderson, WT[1]; Buhler, W[2]; Hein, M[1].

[1]National Institute for Occupational Safety and Health; [2]North Carolina State University

Agricultural workers manually harvesting tobacco have the potential for high dermal exposure to pesticides, particularly on the hands. Often gloves are not worn as it hinders the tobacco harvesters ability to harvest the tobacco leaves. To help reduce pesticide residue on the hands, the EPA Worker Protection Standard requires growers to have hand wash stations available in the field. The purpose of this study was to investigate the acephate residue on the hands of tobacco harvesters, and the effectiveness of hand washing at reducing the acephate residue. Hand wipes from the hands of twelve tobacco harvesters were collected for the morning shift during the lunch break and for the afternoon shift at the end of the workday over two days. Each harvester had one hand wiped prior to washing his hands, and the other hand wiped after washing his hands with soap and water. In addition to the hand wipe samples, leaf wipe samples were collected from 15 tobacco plants to determine the amount of acephate residue on the plants. The tobacco fields were sprayed with Acephate 75SP (EPA Reg. # 51036-236) containing 75 % acephate between 6 to 11 days prior to harvesting. The tobacco plants from each field had similar acephate residue on the leaves. The average leaf residue was 1.42 ng/cm^2 with a range of 0.62 to 3.76 ng/cm^2. The geometric mean (GM) for pre-wash hand wipe samples was 10.74 ng/cm^2, however mean levels varied over the sampling periods with significantly higher day 2 afternoon than day 1 afternoon pre-wash acephate levels (GM 28.37 ng/cm^2 versus 4.92 ng/cm^2 respectively, $p = 0.0051$). Washing the hands significantly reduced the amount of acephate residue on the hands. The GM for post-wash hand wipe samples was 0.38 ng/cm^2 ($p < 0.0001$). However, not all residue was removed by washing the hands. Accumulation of acephate on the hands was seen over the two days. Post-wash acephate levels were significantly higher on day 2 than on day 1 for both morning (GM 0.44 ng/cm^2 versus 0.12 ng/cm^2, $p = 0.0019$) and afternoon (GM 1.47 ng/cm^2 versus 0.26 ng/cm^2, $p < 0.0001$) samples. In addition, afternoon post-wash acephate levels were higher than morning levels on both day 1 and day 2, but only significantly on day 2 ($p = 0.0015$). Acephate levels were not significantly different between the left and right hands for both pre-wash ($p = 0.1330$) and post-wash ($p = 0.3716$) samples. Substantial amount of acephate residue is being transferred to the hands from the tobacco leaves during harvesting. Hand washing with soap and water removes a significant amount of acephate residue from the hands, however, not all acephate is removed by washing. As a result, it appears that acephate residue tends to accumulate on the hands over time despite hand washing efforts.

10609-Prostate Cancer and Estrogenic Pesticides: Is There a Relationship? I. The Role of Occupation

Jacqueline Quail (1,2), Helen H. McDuffie (2), James Gomes (1,2), Anne Leis (1)

1. Department of Community Health & Epidemiology,
2. Institute of Rural, Agricultural, and Environmental Health (I ARE H),
University of Saskatchewan, Saskatoon, Saskatchewan, Canada

Previous studies have suggested that men with occupational exposure to pesticides have an increased risk of prostate cancer. We investigated the putative relationship between prostate cancer and exposure to pesticides with estrogenic qualities, specifically organochlorines and pesticides contaminated by dioxin. We investigated cases of prostate cancer diagnosed in Saskatchewan in 1999, using a case-case cross-sectional study design in which diagnosed cases were assigned to one of two groups based on job titles: "potentially occupationally exposed to estrogenic pesticides" or "not occupationally exposed." Differences in prostate tumor stage, grade, age at diagnosis, and PSA levels at diagnosis are the outcomes of interest. Data were collected by reviewing medical charts and by a mailed, specifically designed, structured questionnaire which was pilot tested. The Saskatchewan Cancer Agency (SCA) provided information from the medical charts of study participants, including tumor grade and stage at diagnosis; PSA levels at diagnosis; medical history; and age, height, and weight at diagnosis. The mailed questionnaire was used to collect detailed information on occupational history, family history of cancer, smoking history, and occupational exposure to selected pesticides. The questionnaire captured characteristics of occupational exposure to selected pesticides by exposure (yes/no) and by the number of years, days per year, and hours per day of exposure to selected pesticides. Completed surveys were returned by 72.0% of eligible cases (n=367). The mean number of permanent jobs held throughout the lifetime was 2.8, with a range of 1 to 9 jobs. Considering that most cases have held more than one job in their lifetime, the most common occupations reported were Farmers and Farm Labourers (n=219), Managers and Officials (n=49), Clerical and Office Workers (n=36), Truck Drivers (n=32), Teachers (n=27), Sales Workers (n = 25), and Mechanics (n=23). Occupations were divided into two categories: those with potential exposure to pesticides (n=238) and those without exposure to pesticides (n=121), with data missing for 8 cases. There was a significant difference (p=.02) in mean age at diagnosis between men who have ever worked in pesticide exposed occupations and those who worked in occupations free from pesticides.(mean age = 71.04 years versus 68.97 years respectively). Farming occupations were specifically examined and a significant difference (p = 0.003) in mean age at diagnosis was found between men who have ever worked as farmers or farm labourers in their lifetime versus those who have not. (mean age = 71.34 years versus 68.7527 years respectively). The results indicate that men who work in occupations with potential pesticide exposure are likely to have a higher mean age at diagnosis of prostate cancer than men who do not.

10635-NON-OCCUPATIONAL DETERMINANTS OF SERUM DDT AND P,P'DDE IN MEN FROM CHIAPAS, MEXICO

Barraza-Villarreal A.[1], Farías P. [1], de Jager C. [2], Hernández-Ávila M. [1], Dewailly E. [3], Ayotte P. [3], Díaz-Sánchez V. [4]

1 Instituto Nacional de Salud Publica, Mexico
2 University of Pretoria, South Africa
3 Centre de Sante Publique de Quebec, Service Sante et Environnement,Quebec, Canada
4 Instituto Nacional de la Nutricion, Mexico

A cross sectional study was conducted in order to evaluate non–occupational biological exposure to DDT and to identify the main factors associated with such exposure in 144 men. The mean age of the study population was 28 years. Information about sociodemographic characteristics and alimentary intake was obtained by means of a questionnaire and serum DDT and its metabolites were determined by mass spectrophotometry. Mean serum levels of p,p'DDE and DDT were 203.47 ug/l and 67.41 ug/l, respectively. The main determinants of both serum p,p'DDE and DDT levels were period of residence in the study area, having been born in the study area and living in a house that had been sprayed with DDT for malaria control. In spite of chlorinated pesticides being banned in Mexico for agricultural use more than 15 years ago and for anti-malarial campaigns about 10 years ago, serum levels found were high. Since chlorinated pesticides are still used in Mexico, this poses a latent health threat for the population given the fact that they persist in the organism for long periods of time. These findings demonstrate the role of anti-malarial campaigns as a contributory factor for high serum levels of DDT and emphasize the need for interventions to control such exposure.

10655-The Effect of Data Quality on Case Determination in a Pesticide Surveillance System.

Judith A. Bardin, Sc.D.[1], James VanDerslice, Ph.D. [1]
[1]Office of Environmental Health Assessment, Washington State DOH

Washington State Department of Health Pesticide Illness Monitoring System (PIMS) receives notification of suspected cases of both occupational and non-occupational pesticide poisonings/illnesses from multiple sources. The major referrers include the Department of Labor and Industries, Washington Poison Control (WPC), Washington State Department of Agriculture, health care providers, and victims or families. In the year 2000 DOH was unable to make a determination in 30% of the reported cases.
Objective: to identify the factors associated with cases where no determination could be made.
Methods: A review of all records from that year was conducted to assess the type and quality of data provided by each referral source.
Results: Most health care providers report directly to WPC, little overlap exists between referral sources, data timeliness is the most essential factor for a successful case determination, and quality of data has little affect on the ability to make the determination.
Conclusion: For occupational injuries, other factors such as type of exposure or injury may affect our ability to make a case classification. The data support the need for early notification of pesticide illnesses. Efforts to increase notification by health care providers and individuals are therefore essential to obtain a more complete picture of pesticide exposures and illnesses.
Research supported by NIOSH grant # 5 U01 OH07296-02

10698-URINARY PORPHYRIN EXCRETION IN A POPULATION HIGHLY EXPOSED TO AIRBORNE HEXACHLOROBENZENE

Jordi Sunyer [1,2], Núria Ribas-Fitó[1], Maria Sala[1], M. Dolores Ozalla[3], Jordi To-Figueras [4], Joan O. Grimalt[5], Xavier Basagaña[1], Carmen Herrero[3]

(1) Respiratory and Environmental Health Research Unit, Institut Municipal d'Investigació Mèdica. Barcelona, Spain.
(2) Universitat Pompeu Fabra. Barcelona, Spain.
(3) Porphyria Unit, Department of Dermatology, Hospital Clínic. Barcelona, Spain.
(4) Toxicology Unit, Hospital Clínic. Barcelona, Spain.
(5) Department of Environmental Chemistry, ICER-CSIC. Barcelona, Spain.

OBJECTIVE: Porphyria cutanea tarda (PCT) is caused by hexachlorobenzene (HCB) in several species of laboratory mammals. Evidences in humans are contradictory. In a study in adults of a highly exposed population to HCB (Flix, Catalonia, Spain) prevalence of PCT was not increased. However, variations in individual urinary porphyrins, in relation to HCB were not studied. We aim to analyse the association of subclinical changes in urinary porphyrin excretion in association with HCB and other organochlorinated compound levels in a highly exposed population.

METHODS: A cross-sectional study including biological samples was carried out on 608 inhabitants of Flix older than 14 years in 1994. Of them, 241 subjects were included for the present study. Total urinary porphyrins were quantified using spectrofluorometry. Porphyrin profile was determined by high-pressure liquid chromatography. Serum HCB, as well as the common organochlorinated compounds, was analysed by gas chromatography coupled to electron capture detection.

RESULTS: Coproporphyrin I (CPI) and coproporphyrin III (CPIII) were the major porphyrins excreted. Total uroporphyrins and CPI and CPIII decreased with increasing levels of HCB ($p<0.05$). This negative association was not explained by age, alcohol, smoking, or the other organochlorinated compounds. CPIII increased with smoking ($p<0.05$). No association was found between uroporphyrin I and III excretion and HCB levels.

CONCLUSION: High airborne HCB exposure in humans moderately affect the porphyrin metabolism, but without producing clinical Porphyria, and with a different pattern than in animal models.

10732-Survey of Health and Pesticide Exposure amongst Sheep Farmers and other Agricultural Workers;
How much can we learn from farmers with exposure and long term ill health?

Tony Fletcher[1], Rachel MacLehose[1], Goran Jamal[2], Peter Julu[2], Fintan Hurley[3] and John Cherrie[3].
[1] Environmental Epidemiology Unit, London School of Hygiene and Tropical Medicine
[2] Department of Neurology, Central Middlesex Hospital, Imperial College of Science Technology and Medicine
[3] Institute of Occupational Medicine, Edinburgh

Background: The aim of this study was to investigate the chronic health effects of organophosphate pesticides (OPs), taking as a starting point. the experience of a large group of farmers, many of whom suspect their illness is due to OPs. Farmers had been required by law for a number of years to dip sheep or treat cattle for warble fly using products that contained OPs. Some studies of active farmers had identified rather mild effects, but concern remained that selective drop out from active sheep farming meant that potentially disabling illness was not detected in cross sectional studies. We therefore used a case series approach in this study and this paper will focus on the methods used to assess these effects, methods which incorporated a participatory element, involving sheep-famers and their advocates in the protocol development.
Methods: With the support and contribution of four advocacy/support organisations, we developed an interview schedule and contacted participants for consent to participate. Participants in this study were recruited via these groups by means of a letter and information sheet and follow up phone to ensure that the eligibility criteria were met. If eligible, participants were scheduled to have a structured telephone interview (CATI). After all the telephone interviews were completed participants were sent a transcript of their responses for checking and amendments. Some participants, who could not be reached by phone or preferred a written version, completed a written version of the questionnaire. Data collection is nearly complete; analyses of the data focuses on consistency of patterns of symptoms and reported diagnoses between subjects with similar reported exposures. For a sub-set selected from strata defined by frequency of autonomic and peripheral nervous system effects, respectively, detailed neurological examinations are being performed.
Results: 491 individuals with probably OP exposure were deemed eligible and gave consent to participate: of these the participation rate for the telephone interviews was 96%. The participatory framework for protocol development and implementation achieved an excellent participation rate for the telephone interviews. The two telephone calls that each participant received were likely to have reassured them about the nature of the study and also provided an opportunity to personally ask questions about the study. A further 695, most of whom could not be reached by phone to seek consent, were contacted by post. Questionnaires and data collection is not completed, but the response rate is only approximately 30%. Results of the analyses of these data will be presented, along with consideration of how much such data contributes to the understanding of the aetiology of OP related ill health.

10784-Evaluation of body burdens and geographical patterns of persistent organic pollutants (POPs) in Alaska Natives

Socha, Marie (ATSDR); Rubin, Carol (CDC/NCEH); Brock, John (Warren Wilson College)

The object of this research was to: (a) determine the overall body burdens of persistent organic pollutants (POPs) in a sample of female Alaska Natives and determine how they compared with the values found in the NHANES II study; and (b) determine any geographical concentration patterns for these POPs in the serum samples that were provided. POPs, also known as organochlorines, include chemicals such as DDT, hexacyclochlorohexane, dieldrin, hexachlorobenzene, and other chlorinated pesticides. Polychlorinated biphenyl (PCB) congeners are also included in this group. These chemicals are being found in Artic areas that previously were thought to be free of such exposures. Recent research has shown these chemicals are traveling northward on the airstream to the Arctic where they precipitate out of the air and move into the biological life cycle. The chemicals are then assimilated into the local wildlife such as marine mammals (beluga whale, northern fur seal, ringed seal), fish and land animals (polar bear). Many Arctic communities tend to utilize subsistence hunting of these animals, fish, and marine mammals in order to support their daily energy needs. By ingesting subsistence foods, any POP chemicals in these food sources would then be transferred to the people who consumed them. These chemicals are lipophilic; they tend to accumulate in the body fat. Elimination of these chemicals is relatively slow and body burden increases as one gets older. The samples were obtained from the Center for Disease Control and Prevention and Indian Health Service Arctic Investigations serum bank. These samples were analyzed for 11 chlorinated pesticides and 27 PCB congeners. The

primary analytes that were elevated in the overall body burden sample were: p,p'-DDE, 9.72 ± 5.86 ppb; PCB congener 153, 2.11 ± 1.92 ppb; Hexachlorobenzene, 1.76 ± 1.89 ppb; PCB congener 138, 1.02 ± 0.85 ppb; and trans-nonachlor at 0.78 ± 1.00 ppb. These levels were not elevated in comparison with the NHANES II environmental data (Alaska data was reanalyzed using the NHANES II detection limits for this step). For the evaluation of POP concentrations based on the geographical unit of residence, significant differences were found between geographical regions for beta-hexachlorocyclohexane, dieldrin, hexachlorobenzene, oxychlordane, trans-nonachlor, and PCB congeners 74, 118, 138, 153, and 180. PCB congeners were found to have the highest concentrations in the southwestern service area (Yukon, Kushkokwin, and Bristol Bay). Beta-hexachlorocyclohexane, dieldrin, hexachlorobenzene, oxychlordane, and trans-nonachlor were found to have the highest concentrations in the northwest service area (Barrow, Kotzebue, and Norton Sound). These geographic regions border coastal areas. It is also known that these communities tend to utilize more lipid-laden food sources (such as marine mammals), thus potentially increasing their body burden levels.

10805-An Examination of Exposure Database Limitations

Jason E. Johnston, M.S., Carolyn G. Scrafford, and Carrie L. Daniels, Novigen Sciences, Inc.

The Pesticide Handlers Exposure Database (PHED) was developed by U.S. EPA, Health Canada and Crop Life America to provide a tool with which to estimate exposures for handlers who mix, load and apply pesticides in agricultural settings. The database has also been used to estimate exposures for residential applicators. Limitations of PHED as an exposure assessment tool have become apparent after a number of years of use. Currently, an industry task for is beginning to collect up-to-date exposure data in order to develop a new database to replace PHED. The purpose of this study is to discuss some of the limitations of PHED, illustrate their impact on assessment of occupational exposures to pesticides, and to provide insight into issues that should be addressed in efforts to develop the next generation handler exposure database.

The fundamental assumption of PHED and similar exposure databases is that the magnitude of handler exposure is a function of formulation type, application equipment, personal protective equipment and, primarily, the amount of active ingredient handled. For some handler activities, e.g., open pour mixing/loading of liquids, examination of the data demonstrates that this assumption should be implemented with care. Variability in estimated unit exposures increases as the actual quantity of material handled is decreased. Procedurally, this finding suggests that participants in exposure studies should handle "real world" quantities of pesticides to produce reliable exposure estimates.

A second limitation of PHED is the preponderance of non-detects (and presumed non-detects) for various body parts in the database. Analysis of the data indicates that assumption of exposures at one-half the detection limit contributes substantially to total exposure for some replicates. This problem is exacerbated by the reliance of early studies on patch dosimeters rather than whole-body dosimeters. Emphasis on whole-body dosimeters in the new database would render obsolete the procedure adopted in PHED (out of necessity due to data gaps) in which central tendency exposures are estimated for each body part and summed. Another detection limit issue is the existence of some very high detection limits for some study replicates. In many cases, assumption of exposure at one-half the limit of detection for these replicates results in estimated individual exposures that are considerably higher than the highest measured exposure.

PHED is a useful tool to estimate occupational and residential exposures to pesticides. Nonetheless, the limitations of PHED are recognized, and attention to the issues described above should be considered in industry efforts to develop a state of the art database.

10870-Immune response in pesticide applicators exposed to 2,4-dichlorophenoxyacetic acid.

Bell, EM; Vermeulen, R; Tollerud, DJ; Rothman, N; Blair, A

Epidemiologic studies have suggested an increased risk of non-Hodgkin's lymphoma (NHL) with exposure to 2,4-dichlorophenoxyacetic acid (2,4-D), a commonly used herbicide. Given that 2,4-D has not been shown to be carcinogenic in animals and that humans excrete 2,4-D largely unchanged, a plausible biological mechanism to support the epidemiologic evidence is not known. While major risk factors for NHL are not understood, studies have shown a consistent and strong relationship between factors that alter the immune system and NHL. Thus, an underlying mechanism of action that alters the regulation of immune function may be at work. The primary objective of this study was to assess measured levels of immune function parameters in relation to 2,4-D exposure. Thirty-four 2,4-D applicators were enrolled into this study. Blood samples were obtained prior to and at the completion of the 2,4-D application season (approximately 12 weeks). Several urine samples were collected from each applicator throughout the application season. Thirty non-applicators, matched on age, race and gender, were selected to serve as a control group. Blood and spot urine samples were collected from controls at enrollment. Questionnaires were used to assess potential confounders (i.e. health status on day of specimen collection, health and smoking history) for all study participants. Serum levels of cytokines (i.e. il_2, il_6, il_12); immunoglobulins (i.e. igg, igm, iga), white and red blood cell and lymphocyte counts were measured. Concentrations of 2,4-D were measured in urine. Differences in the mean levels of the immune system biomarkers between the applicators and controls were assessed using the non-parametric Wilcoxon test. No significant differences were detected. Similarly, no significant differences were observed for the repeated measures in applicators. Overall, serum levels of pre and post application biomarkers were similar with a correlation coefficient greater than 0.80 for 10 of the 15 measured parameters. However, ANOVA showed a large proportion of the total population variance could be attributed to differences between individuals. The large intra-individual variation of immune parameters at baseline may have hindered our ability to fully assess the impact of exposure on immune function. Therefore, the use of methods designed to assess repeated measures (e.g. using the individual as their own control) may help to better characterize exposure effect. In addition, a combination of a small number of exposure measures with large intra-individual variation in exposure levels can lead to imprecise estimates of long-term exposure. Therefore, in order to best assess any immune response resulting from 2,4-D exposure, planned analyses include modeling the urinary 2,4-D measurements in order to infer exposure determinants. Daily information reported by the applicators (i.e. total application hours, application methods and use of personal protective equipment) will be used to derive a continuous exposure measure. This improved measure of exposure will be incorporated into repeated measure analyses, adjusted for potential confounders, in order to assess changes in immune function over the duration of the 2,4-D application season in these thirty-four applicators.

10901-Organochlorines and Risk of Prostate Cancer

KJ Aronson, JWL Wilson, JC Nickel, JPW Heaton, A MacNeily, A Morales.
Queen's University, Kingston, ON, K7L 5H6, Canada

Organochlorines are a class of chlorine-containing organic chemicals, such as DDT, its metabolite DDE, and polychlorinated biphenyls (PCBs). Due to their complex structure and lipid solubility, organochlorines persist in soil, water, and in the food chain. There is very little evidence regarding the role of organochlorines in the etiology of prostate cancer. Within a case-control study evaluating prostate cancer risk and several factors, this analysis determined risk associated with plasma organochlorine concentration. All men scheduled for prostate core biopsy from 1997 through 1999 in Kingston, Ontario were eligible and 90% agreed to participate. Subjects completed a questionnaire and donated 32 mL of blood. After biopsy and pathology for the 239 eligible subjects, 79 were new prostate cancer cases. The remainder (n=160) had a variety of benign prostate conditions: after excluding 25 with prostatic intraepithelial neoplasia 135 "biopsy controls" were included. Urology patients with normal prostate-specific antigen and of similar age as cases were also enrolled (n=194), for a total of 329 controls. This study included ten PCBs and eight pesticides in the analysis, with adjustment for total lipids. Most factors are similar for cases and controls. Geometric means for PCB and pesticides are similar between cases and controls. Adjusted for age, hormones, physical activity as a teen, and family history of prostate cancer, odds ratios (ORs) are consistently above 1.0 for almost all pesticides, for example Oxychlordane (OR= 1.48, CI: 0.73-2.98) and HCB (OR=1.48, CI: 0.75-2.91) and not for PCBs. However, clear associations between organochlorines and prostate cancer risk were not demonstrated in this study.

10905-Use of Biomonitoring to Measure Occupational Exposures for Mixer/Loaders Using Closed Liquid Transfer Systems

Jason E. Johnston, M.S., Novigen Sciences, Inc., D. Larry Merricks, Ph.D., Agrisearch Inc.

A challenge facing investigators who seek to measure very low exposures experienced by handlers of pesticides is the impact of non-detect results from passive dosimetry on the total estimated exposure. For example, handlers utilizing closed transfer systems to mix and load liquid formulations are expected to experience very low exposures. Assumption of exposure at one-half the detection limit could significantly overstate actual exposures. Biomonitoring provides a mean to overcome this limitation of passive dosimetry studies.

Sixteen mixer/loaders participated in this study. Emulsifiable concentrate methyl parathion formulation was transferred to a closed mixing tank from15 gallon containers equipped with the MICRO MATIC DV closed transfer system. Upon mixing, the pesticide was transferred to fixed-wing aircraft equipped with spray booms. Mixer/loaders wore label required personal protective equipment and performed sufficient mix/load cycles to handle a target 900 pounds of active ingredient.

The key to a successful biomonitoring study is the existence of a biomarker and knowledge of the relationship between biomarker and exposure. Para-nitrophenol (PNP) is a metabolite of methyl parathion that is excreted in the urine. However, PNP is not unique to methyl parathion exposure, which introduced challenges to this study. Study participants were housed in "semi-confinement" away from known sources of PNP and PNP precursors for two days, during which 24-hour urine samples were collected. These samples provided a measure of "baseline PNP" excretion. Following the exposure (i.e., completion of mixing/loading task), 24-hour urine samples were collected for three additional days. Baseline PNP excretion was subtracted from each 24-hour post-exposure sample to estimate the PNP excretion attributable to methyl parathion exposure. Following dermal exposure to methyl parathion, rats excrete 91.8% of the absorbed methyl parathion as PNP. Thus, absorbed methyl parathion exposure can be estimated from the quantity of PNP excreted with this factor in addition to factors to account for field fortification recovery of analytical samples and molecular weight differences.

The 16 participants in this biomonitoring study handled 113.5 to 228 pounds of methyl parathion. Estimated absorbed methyl parathion ranges from 0.09 to 115 µg, or 0.0001 to 0.22 µg per pound active ingredient handled. The geometric mean unit exposure was estimated to be 0.0083 µg/lb ai, which is over 1000-fold below the EPA default PHED unit exposure for closed system mixing/loading of liquids. Thus, this biomonitoring study was successful in measuring very low methyl parathion exposures experienced by mixer/loaders utilizing state-of-the-art closed liquid transfer systems.

10935-Validation of a long-term, pesticide exposure assessment model with biomarker data from residents of Kern County, California.

Ritz B, Krishnadasan A, Rull R, Broeske D

We compared a geographically based model of residential and occupational historical pesticide exposure of 30 long-term residents of Kern County, California, to biomarkers of organochlorine (OC) pesticides measured in the blood in 2001. Our model combines pesticide use data provided by the California Pesticide Use Report (PUR) system beginning in 1972 and residential and occupational location history obtained from residents to estimate pesticide exposure likelihood. Our model assumes that exposure likelihood is related to residential or occupational proximity to agricultural applications. To estimate exposures prior to 1972, we used crop/land-use maps, farm advisor reports, and correspondence with pesticide applicators, who worked between 1950 and 1970 in Kern County. We conducted interviews with subjects to obtain information on residential and occupational pesticide use, high pesticide exposure events, smoking history, and residence in Mexico, body mass index, race and breastfeeding. The p,p'-DDE blood serum levels of the subjects ranged from 0.8 to 132.8 mcg/L with a mean of 12.15 mcg/L, and a median of 5.55 mcg/L. Our analyses indicate that organochlorine blood levels are associated with years lived in Mexico, Hispanic race, low educational status, and ever applying, mixing or loading pesticides. We will present comparisons between period and location specific residential and occupational OC exposure estimates based on our model with OC residues in the blood accounting for organochlorine half-life and other predictors of OC biomarker levels and discuss the validity and usefulness of long-term exposure assessment models for future epidemiologic studies of pesticide health effects.

10976-Improving Reporting by a Poison Center to a Pesticide Poisoning Surveillance System

Catherine L Thomsen, Oregon DHS, Environmental & Occupational Epidemiology
B Zane Horowitz, Oregon Poison Center, Oregon Health & Sciences University
Daniel L Sudakin, Oregon State University, Dept. of Environmental & Molecular Toxicology
Sandy Giffin, Oregon Poison Center, Oregon Health & Sciences University

Poison Centers are often consulted by the public and health care providers in the management of pesticide piosonings. Although suspected pesticide-related illness and injury (PRII) is a reportable condition in many states, nine of which have surveillance programs, Poison Centers have not always been partners in reporting. The Oregon Poison Center (OPC) has been an active reporting source for Oregon's PRII surveillance system for more than 15 years. However, an Oregon comparison of these data sets from 1994-1998 found that only 1% of pesticide-related calls to the poison center (many symptomatic) were referred to the state surveillance system. Automation and training were successful in increasing reporting, and decreasing the referral burden on both the case managers and administrators signifcantly in 2000. However, two subsequent reviews found that even some of the more severe cases were still not referred to the surveillance system. A GIS study found that the more events occurring in rural areas were not reported. A review of quarterly OPC pesticide-related calls also indicates that a large number of possible PRII cases were not referred to the state surveillance system. We suggest that reporting can be further improved through a programming change in the software used by OPC (and the majority of U.S. Poison Centers), TOXICALL®. With the development of an additonal software function to select PRII criteria and automatically report cases to surveillance systems, the burden of reporting will be virtually eliminated for the poison center (as demonstrated by the California system). In the absence of such a program change, frequent training of staff and poltical will on the part of administration should improve reporting.

11003-METABOLITES OF ORGANOPHOSPHATE PESTICIDES IN THE URINE OF PRESCHOOL CHILDREN OF MIGRANT FARM WORKERS

Lambert W. (1), Muñiz J. (1), Scherer J. (1), Richman J. (1), Mann-Gaytan R. (2), Phillips J. (2), Mahoney E. (1), and McCauley L. (1)

(1) Oregon Health & Science University, Portland, OR, USA, (2) Oregon Child Development Coalition, Wilsonville, OR, USA

Children of migrant farm workers are at increased risk of exposure to organophosphate (OP) pesticides because of "carry-home" transport processes and residential location. While this at-risk status is generally recognized, little data are available describing the extent of this exposure. Our preliminary research discovered elevated levels of dialkyl phosphophates in spot samples of urine collected from preschool children at a Migrant HeadStart center. Dimethylthiophosphate (DMTP), a primary metabolite of azinphos methyl and phosmet, two OP pesticides known to be used on pears and apples grown in the community, were measured at levels exceeding 600 ug/g creatinine in two of 14 children. Detectable levels of DMTP were observed in 13 children, suggesting extensive exposure. This finding compelled us to survey a large number of preschool children enrolled in Oregon's Migrant HeadStart Program. Our objective is to characterize urinary dialkyl phosphate levels in young children whose parents work in a variety of agricultural activities, including harvesting of tree fruits and berries, and in nurseries where ornamental plants and Christmas trees are grown. During the summer and fall of 2001, we collected serial samples of urine from 221 children, 2 to 5 years of age. Up to three urine samples were collected from each child at the beginning, mid-point, and end of the work season. The survey was performed in three communities with differing agricultural crops and OP pesticide use. Sampling was also conducted in a reference group of Hispanic children living in an urban area in which occupational exposure to parents was much less likely to occur. Quantification of dialkyl phosphate compounds in the urine samples will be completed by summer of 2002. This paper will characterize differences in exposure by community, and develop pesticide dose estimates.

11063-Factor Analysis of Pesticide Use Patterns Among Pesticide Applicators in the Agricultural Health Study

Claudine Samanic[1], Jane A. Hoppin[2], Jay Lubin[1], Aaron Blair[1], Michael C. R. Alavanja[1]
National Cancer Institute[1], National Institute of Environmental Health Sciences[2]

Farmers and other pesticide applicators experience a wide variety of chemical and biological exposures that could contribute to increased risks for cancer and other health outcomes. Because these exposures often occur simultaneously, characterizing patterns of exposure may provide more insight into etiologically relevant activities, than evaluation by single factors. Factor analysis allows the reduction of a large number of correlated exposure variables into distinct patterns of exposure by identifying a smaller number of latent patterns that explain the majority of the variance observed in the larger set of variables. Using data from the Agricultural Health Study (AHS), a prospective cohort study of licensed pesticide applicators and their spouses in Iowa and North Carolina, we examined the underlying patterns of self-reported exposure to 50 pesticides by using factor analysis. Data were obtained through a self-administered questionnaire completed at study enrollment (December 1993 - December 1997). Factors describing individual pesticide use were obtained from data on ever/never use of 50 pesticides. We evaluated pesticide factors for three types of applicators in the cohort: farmer applicators, spouses of farmer applicators, and commercial applicators. Approximately 50% of the spouses, primarily women, reported applying pesticides sometime during their lifetime. Among farmer applicators (N=45,074), three factors emerged that explained 90% of the variance in the observed data: 1) Iowa agriculture and herbicide use, 2) North Carolina agriculture and use of insecticides, fungicides and fumigants, and 3) age over 50 and chlorinated pesticides now banned from use in the U.S. The patterns among spouses (N=31,266) included an additional factor for home and garden use of pesticides; these four factors explained 98% of the variance. For commercial applicators (N=4,384), five factors emerged explaining 96% of the variance, and included 1) herbicide use, 2) chlorinated pesticides, 3) fungicides and residential pest treatments, 4) animal insecticides, and 5) fumigants. These analyses suggest that while spouses on farms have similar patterns of exposure as their licensed applicator spouses, they also have additional pesticide application activities that need to be considered when evaluating health effects of exposure to pesticides. The commercial applicators, all residents of IA, engaged in a wider variety of pesticide application activities compared to farmer applicators and their spouses. In this study, factor analysis was a useful tool for identifying patterns of pesticide use that clearly differed among subgroups in the cohort. These relationships can be used to guide exposure assessment efforts by identifying which exposures tend to occur simultaneously, and to focus etiologic studies of the health effects of farming by identifying the interrelationships among various types of exposure variables.

11142-Cholinesterase Levels and Risk Factors for Pesticide Exposure among Peruvians Farmworkers

Laura Nayhua, General Office of Epidemiology
Aquiles Vilchez, National Institute for the Protection of the Environment
Luis Suarez, General Office of Epidemiology
Mabel Jímenez, General Office of Epidemiology
Mildred Maisonet, Panamerican Health Organization

The purpose of this investigation was to determine cholinesterase levels and risk factors for pesticide exposure among farm workers from the Province of Lima. Data collection was conducted in 2000. The study group consisted of a sample of 385 individuals between 15-64 years old. Trained interviewers used a standardized questionnaire to obtain information on risk factors. Data collection included information on demographics and pesticide use and storage. Eighty percent of the participants were male and the mean age of the group was 36.4 years. Cholinesterase levels ranged from 1294 to 7517 U/L. The mean cholinesterase level of the study group was 4810.6±1091.6 U/L. None of the participants uses protective gear during pesticide handling and nearly half of them reported using organophosphate pesticides. We looked at mean cholinesterase levels for different categories of risk factors. Results of the preliminary analyses showed little variation in mean cholinesterase levels among risk groups. Our study does not suggest a relation between cholinesterase levels and risk factors for increased pesticide exposure. One limitation of this study is that we don't have information on the baseline cholinesterase levels of this group.