The economic burden of occupational injuries and diseases in the countries considered are substantial, despite efforts to reduce adverse workplace exposures. Our case costs and total economic burden estimates provide a basis for undertaking economic evaluations of prevention efforts and can serve as a template for monitoring and evaluation at the country level. We advance the methods on several fronts.

Solvents

02D.1 A FOLLOW-UP STUDY OF OCCUPATIONAL STYRENE EXPOSURE AND RISK OF SYSTEMIC SCLEROSIS, RHEUMATOID ARTHRITIS, AND OTHER SYSTEMIC AUTOIMMUNE RHEUMATOLOGICAL DISEASES

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Background Increased risk of systemic sclerosis, systemic lupus erythematosus, rheumatoid arthritis, primary systemic vasculitis, and systemic Sjogren's syndrome has been suggested following occupational solvent exposure. The evidence for specific solvents is, however, limited and little is known about exposure and risk patterns.

Aim Our aim is to examine the exposure response relation for systemic sclerosis, rheumatoid arthritis, systemic lupus erythematosus, primary systemic vasculitis, and systemic Sjogren's syndrome following occupational styrene exposure.

Methods We followed 72 467 styrene exposed workers of the Danish reinforced plastics industry from 1977–2012. We modelled styrene exposure from employment history, survey data and historical styrene exposure measurements. We identified cases in a national patient register, and investigated gender specific exposure response relations by cumulative styrene exposure for different exposure time windows adjusting for age, decade, educational level and a proxy for tobacco smoking.

Results During 1,553,577 person-years, we identified 223 women and 453 men diagnosed with a systemic autoimmune rheumatological disease, of which three out of four were rheumatoid arthritis. When adjusting for potential confounders and comparing the highest with the lowest styrene exposure tertile, we observed a statistically non-significantly increased risk of systemic sclerosis among men (IRR=1.79; 95% CI 0.48–6.87) and women (IRR=2.58; 95% CI 0.51–12.94), based on 20 and 9 cases respectively. However, for women with systemic sclerosis, we saw a significantly increasing trend of 1.19 (1.01–1.40) per 100 mg/m³-years. Increased risks were also suggested for primary systemic vasculitis (IRR=2.32; 95% CI 0.63–8.52) and rheumatoid arthritis (IRR=1.26; 95% CI 0.95–1.67) among men. Analyses of exposure time windows suggest a latency period for rheumatoid arthritis of about 15 years.

Conclusion This study might indicate that styrene exposure is associated with the occurrence of systemic sclerosis among men and women, and primary systemic vasculitis and rheumatoid arthritis among men.

02D.2 OCCUPATIONAL EXPOSURE TO OXYGENATED, PETROLEUM-BASED AND CHLORINATED SOLVENTS OF WOMEN IN CHILDBEARING AGE IN FRANCE IN 2013

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Objective Occupational exposure to chemical agents including solvents is sparsely described among women although they constitute a vulnerable population at certain points in life and particularly during the procreative period. The aim of this study is to document the occupational exposure to oxygenated, petroleum-based and chlorinated solvents in women of childbearing age (WCA).

Methods We linked 17 job-exposure matrices describing exposure to oxygenated, petroleum-based and chlorinated solvents from the MATGÉNÉ programme to the 2013 French census. The occupational exposure prevalence was estimated in women aged from 15 to 44 years. The occupational exposure prevalence was described by 5 year age group, occupation and worker status (salaried or self-employed).

Results The most frequently used solvents in French workplace in 2013 by WCA are oxygenated solvents (15% of WCA at work, n=1,112,000), then petroleum-based solvents (1%, n=73,000) and chlorinated solvents (0.1%, n=9,000). The younger WCA (15–29 years) are more exposed to oxygenated solvents than their elders (19.9% vs 14.9%). On the contrary, the elderly (35–44 years) are more exposed to petroleum-based and chlorinated solvents. Three quarters of the WCA exposed to at least one oxygenated solvent are civil and public servants (41%), health and social workers (21%) or direct personal services staff (19%). Half of WCA exposed to at least one petroleum-based solvent are drivers (20%) and skilled workers of industrial and artisanal fields (13% respectively). For WCA exposed to at least one chlorinated solvent, nearly half worked as non-skilled workers of industrial and artisanal type (17% respectively) and health and social workers (15%).

Conclusions This study is the first describing occupational exposure to three major solvents' families for the entire working WCA in France regardless of working status or occupation. These information will help in the surveillance of this occupational risk and to prioritize prevention actions.

02D.3 PROTECTIVE EFFECTS OF PPE USE AND GOOD WORKPLACE HYGIENE PRACTICES AGAINST SYMPTOMS OF NEUROTOXICITY IN COLLISION REPAIR WORKERS

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Objectives We have recently shown that solvent-exposed collision repair workers (spray painters and panel beaters) in New Zealand are at an increased risk of both self-reported and objectively assessed neurobehavioural effects, indicating a need for more effective exposure controls. This study assessed the

association between personal protective equipment (PPE) use and workplace hygiene and symptoms of neurotoxicity in vehicle spray painters.

Methods Exposure controls including PPE-use and workplace hygiene practices and symptoms of neurotoxicity were assessed in 267 vehicle repair spray painters. Symptoms were assessed using the EUROQUEST questionnaire.

Results Frequent respirator and glove use was inversely associated with symptoms of neurotoxicity in a dose-dependent manner ($p < 0.05$ for trend). The strongest protective effect was found for consistent glove use (OR 0.1 and 0.2, $p < 0.01$, for reporting ≥ 10 and ≥ 5 symptoms, respectively). A dose-response trend ($p < 0.05$) was also observed when combining frequency of respirator and glove use, with an overall reduction in risk of 90% (OR 0.1 for reporting ≥ 10 and ≥ 5 symptoms, $p < 0.01$) for those who consistently used both. Protective effects were most pronounced for psychosomatic ($p < 0.05$ for trend, for combined PPE use), mood ($p < 0.05$) and memory and concentration symptoms combined ($p < 0.05$), with reductions in risk of $> 80\%$. Poor hygiene workplace practices, e.g. solvent exposure to multiple body parts were associated with an increased risk of symptoms, but this was not statistically significant. When using a general workplace hygiene score derived from a combination of PPE-use and (good) workplace hygiene an inverse dose-response trend was observed for reporting ≥ 5 ($p < 0.01$) and ≥ 10 symptoms ($p < 0.01$).

Conclusions This study has shown that PPE-use and good workplace hygiene are associated with a strongly reduced risk of symptoms of neurotoxicity in solvent-exposed vehicle spray painters. Glove use was most protective, suggesting dermal exposures may be of particular importance in the development of symptoms.

02D.4 BENZENE AND TOLUENE EXPOSURE AND SYMPTOMS AFFECTING WORK ABILITY AMONG THE ROAD SWEEPERS IN POLLUTION CONTROL AREA, RAYONG PROVINCE, THAILAND

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Background Road sweepers exposed to the exhausted smoke and carbon deposit from the vehicles which will stimulate the allergic from various chemicals and affected to their health. The objectives were to evaluate benzene and toluene exposure and symptoms and work ability among the road sweepers in pollution control area, Rayong province, Thailand.

Methods The methods used Organic Vapor Monitor (3M 3500) for collecting air samples adhered to the road sweepers at the level of breathing, and the collection of urine in 20 cc. plastic bottles.

Results The mean age of the study group was 44.05 years. 92.0% of the study group worked 8 hours per day; 63% worked, 6 days per week. 57.0% always used respiratory protection; however, most of them used only cotton masks (97.9%). Most of them about work ability had good level (64.0%). Results of the study group ($n = 100$) showed average

exposure measures of benzene of 20.63 (SD = ± 1.363 ppb), and toluene 86.09 (SD = ± 84.016 ppb). Results of urine samples ($n = 100$), after the work shift, showed average $\pm$ SD of toluene to be 0.001 ± 0.002 $\mu\text{g/L}$. The average comparison of concentration of benzene and toluene was significantly different between the study and comparison groups at level 0.05 ($p < 0.001$ and $p < 0.001$, respectively). However, the relationship between benzene and toluene in the atmosphere and in the urine and work ability of study group were not significant.

Conclusion Based on the results of this study, benzene and toluene in the atmosphere and in the urine and symptoms among road sweepers were detected. Health promotion and protection programs should be emphasized. Respiration protective equipment should also be provided.

02D.5 RISK OF PARKINSON DISEASE IN SOLVENT EXPOSED WORKERS IN FINLAND

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Epidemiologic studies indicate that occupational exposure to solvents may increase risk of Parkinson disease (PD).

We constructed a population-based case-control study of incident PD using a register of Reimbursement of medicine costs of the Social Insurance Institution of Finland, along with the Population Information System, including census records for all Finnish residents. PD cases were diagnosed between 1995–2014. Controls were randomly selected from the population while matching on diagnosis year, birth year (1930–1950), and sex. A total of 11,757 PD cases and 23 236 controls had data from the occupational census in 1990, ensuring ≥ 4 years exposure lagging and 21 years of occupational history data (5 censuses from 1970–1990). We used the Finnish Job Exposure Matrix to assess cumulative exposure (CE) to four groups of solvents (aliphatic/alicyclic hydrocarbon, aromatic hydrocarbon, chlorinated hydrocarbon, other). We estimated PD-solvent odds ratios (ORs) and 95% confidence intervals (CIs) using unconditional logistic regression, while adjusting for age, sex, socioeconomic status and smoking (a_OR), or additionally for CE to chromium and one of the other solvent groups (ab_OR).

In total, 3758 cases (30.4%) and 7445 controls (32.0%) were potentially exposed to solvents (a_OR 0.99; CI: 0.94–1.05). Exposure to chlorinated hydrocarbons was associated with PD (a_OR 1.20; CI: 1.05–1.36; ab_OR 1.21 CI: 1.04–1.40) at the highest CE group (20–145 ppm-years, $n = 409$ cases and 728 controls) but not at lower CE levels. Overall, CE to chlorinated hydrocarbons ($n = 1840$ cases and 3693 controls) was associated with increased risk of PD (p -for-trend = 0.01). There was no evidence of a positive association for any of the other solvent groups.

We observed a positive association between occupational exposure to chlorinated hydrocarbons and risk of PD. This was especially true for greatest duration and/or level of exposure.