

**Objectives** To survey the hearing problem and noise exposure of forklift drivers in a factory.

**Methods** A cross-sectional survey was conducted during 2011–2012 among the workers. Data was collected through periodic examination and environmental measurement. A total of 21 people participated in the study (20 males, 1 female).

**Results** The workers were 29–48 years of age and their working years were between 9 to 20 years with the average working time of 40 hours per week. The report of abnormal audiogram was 33.3% (7 people) and one case was later excluded after the repeated test was normal. Two cases were diagnosed with moderate to severe sensorineural hearing loss while the others (5 people) were diagnosed with mild SNHL. All of them were not concerned about ear protective equipment, nor did they utilize such equipment. The environmental measurement was done by sound level meter; Noise Dosimeter. Time weighted average level (8-hr-TWA) was still under the regulations, which were between 80.38 to 85.61dBA.

**Conclusion** Hearing conservative program should be provided to high risk workers even though the noise induced hearing loss was not diagnosed. The periodic examination is important to compare with baseline audiogram.

#### 109 WORK-RELATED NOISE INDUCED HEARING LOSS CASES REPORTED BY PHYSICIANS TO THE NORWEGIAN REGISTRY OF WORK-RELATED ILLNESSES: DATA FROM 2005–2009

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**Background** This study provides an epidemiological profile of hearing loss cases reported to the Norwegian Labour Inspectorate (NLI) and also a distribution of cases by the notifying physician type.

**Materials and Methods** The study is based on obligatory physician notifications of work-related illnesses to the Norwegian Labour Inspectorate. These physician reports are the basis for the Registry of Work-related illnesses. We extracted NIHL data from this registry based on the ICD-10 codes for the period 2005–2009 (5-year period). We also obtained employment data from Statistics Norway by trade sector, gender and age. We then estimated the average number of cases reported in the period 2005–2009. Next we estimated the incidence rates for the reported cases by gender, age and trade sector. We also computed descriptive statistics for occupation and the type of notifying physician.

**Results** In the 5-year period, a total of 7888 cases of NIHL were reported to the NLI. On average 1577 cases of NIHL were reported. 96% of these cases were men. Incidence of reported work-related NIHL was estimated to be 66/ 100 000 workers. The incidence for reported NIHL cases was respectively 6 and 120/100 000 workers for women and men.

The highest incidence was found in age group 55–66. Cases reported from manufacturing, electricity, gas, steam, construction and mining sectors were found to have the highest incidence rates.

Occupational health physicians reported 85% of all the NIHL cases while hospital and general physicians reported 7% and 4% of the cases respectively.

**Conclusions** Work-related NIHL remains an extensive problem, yet an under-profiled problem in Norway. Targeted interventions

toward vulnerable groups to reduce noise exposure to vulnerable groups are necessary.

The registry of work-related illnesses is not ideal in detecting cases of NIHL because of extensive underreporting and remedial measures ought to be taken to address this issue.

#### 110 EFFECTS OF WHOLE BODY VIBRATION ON HEARING LEVEL SHIFTS

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**Background and Aim** Adverse effects of occupational whole body vibration (WBV) on hearing are yet unknown. The aim of the research was to survey effects of whole body vibration on hearing shifts.

**Methods** Male adult New Zealand White rabbits were divided into two groups include control group (n = 6, not exposed to whole body vibration) and vibration group (n = 6, exposed to whole body vibration in the Z-axis at 4 Hz and 1.0 ms<sup>-2</sup> r.m.s for 8 hours per day in 5 consecutive days by putting their box on a vibrating platform). DPOAEs were measured hearing shifts in vibration group in days: zero (before exposure to vibration) as baseline, eighth (an hour after exposure to vibration) as temporary threshold shifts, and tenth (48 hours after exposure to vibration) as permanent threshold shifts. Similarly, DPOAEs were also examined hearing shifts in control group in days zero, eighth, tenth. The gathered data analysed by independent-samples T Test.

**Results** Increased mean DPOAEs amplitudes were observed in frequencies 375.00, 562.50, 750.00, 1125.00, 1312.50, 2062.50, 2625.00, 3937.50, 5437.50, 6562.50 Hz respectively in vibration group. There were no any significant differences between mean DPOAEs amplitudes in days zero, eighth and tenth at all frequencies (p = 0.073).

**Conclusion** The exposure to vibration significantly led to enhanced mean DPOAEs amplitudes at all frequencies at low frequencies rather than at high frequencies. Thus, this study showed that vibration exposure only could not cause temporary or permanent threshold shifts. Increased DPOAEs amplitudes could be probably attributed to normal outer and destroyed inner hair cells.

### Session: O. Biomarker

#### 111 PRODUCTION OF IL-10, TNF AND IL-12 BY PERIPHERAL BLOOD MONONUCLEAR CELLS IN MEXICAN WORKERS EXPOSED TO A MIXTURE OF BENZENE-TOLUENE-XYLENE

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**Objective** To determine relationship between occupational exposure to benzene-toluene-xylene mixture (BTX) and IL-10, TNF and IL-12 production by peripheral blood mononuclear cells.

**Methods** Exposure was estimated in 54 workers from a paint company in Mexico City through BTX accumulated potential dose (BTX-APD). Two exposure groups were formed: high and low BTX-APD established with a cutoff point at  $\geq 1.0$  of BTX-APD, as a function of the geometric mean of the estimator's value distribution and the higher agreement between BTX-APD  $\geq 1.0$  and the areas referred as using (or not) organic solvents in the work process. IL-10, TNF and IL-12 concentrations were measured with ELISA. Through multiple linear regression models, the production of each of the proposed cytokines and of the whole set was assessed.

**Results** Workers with high BTX-APD showed a significant reduction in TNF production ( $\beta = -1,196.0$  pg/mL;  $p = 0.01$ ); a reduction for IL-10 ( $\beta = -520.3$ ;  $p = 0.13$ ) and IL-12 ( $\beta = -843.3$ ;  $p = 0.09$ ) was also observed, although without statistical significance.

**Conclusions** TNF production assessed in workers with a high BTX-APD is lower than in those with a low BTX-APD, but not in IL-10 and IL-12 production.

#### 112 BENCHMARK DOSE ESTIMATION OF HEMATOTOXICITY AND GENOTOXICITY AMONG CHINESE BENZENE EXPOSED WORKERS IN SHOE FACTORIES

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**Objectives** Benzene exposure can induce hematotoxicity and genotoxicity at occupational exposure level below 1 ppm according to previous reports. The purpose of this study was to calculate benchmark dose (BMD) for chromosomal damage and reduced white blood cell (WBC) induced by benzene among the exposed workers in Wenzhou, China.

**Methods** A group of 317 workers occupationally exposed to benzene and 102 unexposed workers were examined for hematotoxicity indicated by WBC count, and for genotoxicity measured by cytokinesis-blocked micronucleus (CBMN) assay with peripheral blood lymphocytes. The cumulative exposure dose (CED) of benzene was calculated basing on the job type and duration of each job and the benzene concentration in workplace. Benchmark Dose Software (BMDS) Version 2.2.1 (US EPA) was used to calculate the BMD and its lower confidence limit, BMDL.

**Results** demonstrated that there was a strong dose-response relationship between benzene CED and the effect biomarkers (the MN frequency and WBC count). The BMDL10 by CBMN frequency were found to be 5.16, 1.84 and 2.35 ppm-year for benzene-exposed male, benzene-exposed female and total exposed workers, and 5.45, 3.94, 10.25 ppm-year by WBC count, respectively.

**Conclusions** 2 ppm for chromosomal damage (CBMN) and 4 ppm for hematotoxicity (WBC) of occupational exposure limits of benzene were suggested according to our findings. Further studies need to be confirmed and validated.

#### 113 FERRITIN MAY PREDICT 5-YEAR RISK OF METABOLIC SYNDROME IN TAIWANESE NON-OBESE MALE WORKERS: INSIGHT FROM AN OCCUPATIONAL COHORT STUDY

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**Objectives** To investigate association between ferritin and 5-year risk of developing metabolic syndrome (MetS) among apparently healthy middle-aged male workers.

**Methods** We established a prospective cohort study in an electronic-manufacturing factory by using a detailed medical checkup program in 2002, and followed up them with a health examination in 2007. Each individual underwent physical examination and blood biochemistry tests; body mass index (BMI), blood pressure, and waist circumference were measured by the registered nurses. We collected data from self-reported questionnaires, ferritin, insulin resistance estimated by homeostasis model assessment (HOMA), and fatty liver revealed by abdominal ultrasound in 2002, and aimed to explore their association with risk of metabolic abnormalities in 2007. MetS was diagnosed according to the modified National Cholesterol Education Program Adult Treatment Panel III criteria accounting for Asia Pacific/Taiwanese population. Cox proportional hazard models were applied to discover if ferritin is a predictor for development of MetS.

**Results** A total of 1493 workers were recruited in this study. Most subjects were males (73.3%) with a baseline mean (SD) age of 32.5 (6.0). Baseline MetS was diagnosed in 21.5% of males, and 14.8% of females. The prevalence of MetS after 5 years significantly increased with the tertiles of baseline ferritin for both genders. In males, ferritin  $>200$  mcg/L was associated with increased risk of MetS. Within 5-year follow-up, incident 114 cases of MetS developed among 877 MetS-free males. Among the non-obese males (BMI  $< 25$ ), ferritin  $>200$  mcg/L may predict MetS with a hazard ratio (HR) of 2.23 (95% C. I. 1.02–4.89) compared to the first tertile ( $<123$  mcg/L) after controlling for age in the Cox models; non-alcoholic fatty liver diseases (NAFLD) was significantly related to new-onset MetS with a HR of 4.83 while a positively increased trend of higher tertiles of ferritin associated with MetS was observed.

#### 114 CANCER-RELATED PROTEINS IN LUNG TISSUE FROM URANIUM MINERS - VARIATION BY OCCUPATIONAL EXPOSURE AND SUBTYPE OF LUNG CANCER

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**Objectives** We investigated the association of cumulative exposure to radon and arsenic with cancer-specific proteins in lung tissue from uranium miners.

**Methods** Paraffin-embedded lung tissue of 147 miners was randomly selected from a biobank established for German uranium miners comprising adenocarcinoma (AdCa), squamous cell carcinoma (SqCC), small cell lung cancer (SCLC), and cancer-free tissue. Within each stratum, we additionally stratified by level of cumulative exposure to radon and arsenic. Lifetime exposure to radon and arsenic was estimated using a job-exposure matrix developed for uranium mining in Germany. For 22 cancer-related proteins, immunohistochemical scores were calculated from the intensity and percentage of stained cells. The association of these scores with exposure to radon and arsenic was