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## 424. Work-related respiratory diseases and specific exposures

### P4169

#### Firefighter occupational exposures in forest fire settings – Three years of the FUMEXP project

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**Introduction and objectives:** There is a growing awareness that smoke produced during wildland fires can expose firefighters and populations to hazardous concentrations of several air pollutants. The FUMEXP Project was developed to evaluate the potential effects of smoke emissions on firemen health.

**Methods:** A sample of firefighters (n=38) was submitted to spirometry and responded to the SF-36® General Health Survey before the 2008 forest fire season, and again at the end of the 2010 season.

During three years (2008-2010), a subsample of 18 firefighters was tested before and after firefighting. Exhaled nitric oxide (eNO), carbon monoxide (CO) and % carboxy-haemoglobin were monitored.

Ten of these firefighters carried monitoring devices to assess particulate matter (PM<sub>2.5</sub>), NO<sub>2</sub>, volatile organic compounds (VOC's) and carbon monoxide, during prescribed/experimental and real forest fires.

**Results:** Values above international recommendations were measured: PM<sub>2.5</sub> > 1,280 µg.m<sup>-3</sup>; CO > 73,000 µg.m<sup>-3</sup>; NO<sub>2</sub> > 4,670 µg.m<sup>-3</sup>. VOC values were also high.

Airway monitoring: there was a significant decrease (p<0.05) on the eNO, and a very significant increase on exhaled CO (p<0.001), pre and post firefighting. Predicted FEV<sub>1</sub>, F<sub>25</sub>, F<sub>50</sub> e MEF were lower at the end of the Project (p<0.05). Three questions of the SF-36 survey had scores significantly lower.

**Conclusions:** With the levels of exposure monitored, forest fire smoke inhalation can cause acute and long term health effects on exposed professionals. Suggested preventive measures include regular health evaluation, use of adequate protecting equipment and individual monitoring devices, planning of fire-fighting shifts and modelling of exposure.

### P4170

#### Systematic review of ill-health outbreaks associated with exposure to water-based metalworking fluids

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**Objectives:** Aims to identify and review all previously published reports of outbreaks of ill health due to water-based metalworking fluids (MWFs), in order to identify aetiological risk factors for disease, and highlight areas requiring further research.

**Methods:** A multidisciplinary team agreed appropriate search terms for a systematic literature review. From a total of 1346 titles, 35 relevant articles, relating to 29 separate outbreaks of ill health attributed to MWF exposure were selected.

**Results:** 17 outbreaks related to respiratory disease, 4 to skin disease, and 8 to a combination of both. There was a peak incidence between 1996 and 2000. The majority were from the United States, from large car manufacturing plants using a central sump. The mean attack rate for allergic respiratory disease during outbreaks was 5.9% of the exposed workforce. Outbreaks were identified with all types of water-based MWFs, and mean MWF aerosol levels were below recommended exposure limits in most cases. For respiratory disease outbreaks, bacteria were isolated in 76%, fungi in 71% and opportunistic mycobacteria in 59% of workplaces. Endotoxin contamination of MWF ranged from non-detectable to 5.3 × 10<sup>5</sup> EU/ml, and measured airborne endotoxin levels ranged from 0.52 EU/m<sup>3</sup> to 126 EU/m<sup>3</sup>.

**Conclusions:** Despite numerous investigations, significant knowledge gaps remain, particularly regarding the aetiology, natural history and risk factors for these outbreaks. The available evidence supports the hypothesis that microbial contamination is important in the aetiology of occupational lung disease in this group, and improvements in workplace hygiene have generally been associated with a cessation of new cases.

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**P4171****Epidemiological study of the workforce after an outbreak of occupational asthma due to chromium and cobalt in an aerospace factory**

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An outbreak of asthma due to chromium and cobalt in 4 employees at an aerospace factory occurred after coolant oils were changed in 2004 (6-24 month latency). The factory machined high chrome and nickel alloys with hard metal tipped tools containing cobalt. Oils and mist exposure met exposure standards. This prompted an investigation of the workforce, in order to measure extent and cause of outbreak. 62 (of 65) employees (m=54;f=8; mean age 34.5; 58% currently working with coolant oils; 58% never smoked) undertook a self-completed symptom questionnaire, lung function, urinalysis and received expert consultation. 74.1% had urinary chromium excretion indicating occupational exposure. 66.1% had at least one respiratory symptom, most symptoms from after 2003. Clinical opinion identified cases of definite or probable lung disease: OA (5; 8%, 3 with positive challenges to chrome and one with cobalt, one not challenged), symptomatic pre-existing asthma (17; 27%) and occupational rhinitis (OR) (18; 29%). All 5 OA cases and 15/18 OR cases worked with coolant oils. Employees with OA, asthma or OR were compared with asymptomatic workers (n=37). Those with OA or OR were of similar age and no more likely to be smokers, have abnormal spirometry or FeNO than controls. Those with OA and OR had significantly higher urine chromium (p=0.05) and cobalt (p<0.001) concentrations and a longer mean duration of employment. OR was more likely in those undertaking manufacturing work (p=0.006) or work with machines using coolant oils (p=0.02). Chrome exposure sufficient to cause occupational asthma can occur from metal-working fluid aerosols when machining high chrome alloys.

**P4172****Past dust and gas/fume exposure and COPD in Chinese: The Guangzhou Biobank cohort study**

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**Background:** The impact of occupational dust and gas/fume exposure on chronic obstructive pulmonary disease (COPD) has been described in Western populations but the extent has not been quantified in developing countries.

**Aims:** We examined the relationship between past dust and fume exposure and prevalence of COPD and respiratory symptoms in a Chinese population sample. We have calculated the population attributable fraction for COPD due to previous occupation exposures.

**Methods:** Baseline data from the Guangzhou Biobank Cohort Study (2003-6; n = 8,219) were analysed. Self-reported intensity and duration of dust and gas/fume exposure was obtained from which a cumulative exposure index was derived. COPD was defined based on spirometry using lower limit of normal. Respiratory symptoms were assessed by the MRC questionnaire.

**Results:** In this sample (27.3% men, mean age 61.9±6.8 years), COPD was associated with dust or gas/fume exposure in a dose-response manner with no evidence of effect modification by smoking (adjusted OR for high level exposure = 1.49; 95% CI 1.21-1.91). Similar associations were found for chronic cough/phlegm (1.60; 1.18-2.17) and dyspnoea (1.38; 1.21-1.58). The population attributable fraction for COPD due to occupational exposure was 11.2% (95% CI 1.4%-20.0%).

**Conclusion:** Occupational dust and gas/fume exposure is associated with an increased prevalence of COPD in this Chinese sample, independent of smoking. The magnitude is similar to that reported in other populations.

**P4173****Long term effect and allergic sensitization in newly employed workers in laboratory animal facilities**

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**Background:** Allergic reactions are common in laboratory animal workers and one of four individuals working with laboratory animals report work-related allergic symptoms and may develop occupational asthma. Working in laboratory animal facilities also implies exposure to airborne dust, contaminated with microbial and other products, which may lead to health effects.

**Objective:** The aim of this study was to identify targets that can predict sensitization to laboratory animals. Skin Prick Test change and sensitization to laboratory animals were used as an outcome variable.

**Methods:** In a prospective longitudinal study newly employed personnel who were employed to work with laboratory animals at Karolinska Institutet (Sweden) were

investigated before and 6, 12 and 24 month after employment. Lung function, bronchial challenges, exhaled NO and nasal lavage were performed and blood samples were taken at each visit.

**Results:** Seventy subjects attended all four visits and 13 of those (19%) became sensitized to laboratory animals during the study. Lung function (VC and FEV<sub>1</sub>) deteriorated (as compared with predicted values) and increased blood levels of eosinophils and IL-2 over time were observed.

An increased risk of developing laboratory animal allergy was significantly associated with female sex, atopy, symptoms, CD4<0.92 cells/μL blood, total IgE>15.5 kUA/L, specific IgE to rat (e87>0.01 kUA/L) and mouse (e88>0.004 kUA/L).

**Conclusions:** One of five subjects became sensitized to one or two laboratory animals in this study and atopic subjects before starting working with animals had a greater risk to develop laboratory animal allergy.

**P4174****Cow hair sensitisation is uncommon among Danish dairy farmers despite high allergen levels**

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**Background:** Bovine allergens can induce allergic airway diseases. Recently high levels of cow hair allergens (CHA) in dust from stables and homes of dairy farmers were reported (Zahradnik E et al. IAAI 2011;155:225-233).

**Objective:** To investigate CHA levels among dairy farmers (DF), pig farmers (PF), former farmers (FF) and never farmers (NF) and to assess CHA sensitisation in these groups.

**Methods:** In 2007-8 415 dust samples were collected using an electrostatic dustfall collector, EDC (Noss I et al. Appl Environ Microbiol 2008;74:5621-7) with a 14 days sampling time among 54 PF, 27 DF, 71 FF and 51 NF. Among farmers sampling was carried out both summer and winter. The cow hair allergen levels (ug/m<sup>2</sup>) were measured using a sandwich ELISA assay (Zahradnik E et al. IAAI 2011;155:225-233). SPT for cow hair allergens (ALK-Abello<sup>®</sup>) were performed among 48 PF, 20 DF, 54 FF and 31 NF.

**Results:** CHA levels were substantially higher in stables than bedrooms. DF had much higher CHA level compared to PF. FF and NF had low levels of CHA in their bedrooms compared to DF and PF. No one but one PF (former DF) was sensitised to CHA.

Table 1. CHA (μg/m<sup>2</sup>) among DF, PF, FF and NF strat. by summer/winter and stable/bedroom. N, median (min-max)

	Stable sum	Stable wint	Bedroom sum	Bedroom wint
DF	20;67900 (9543-196000)	25;34666 (1741-203000)	25;9.5 (1.4-66.8)	26;7.9 (0.8-122)
PF	45;2.1 (ND-24.1)	48;1.4 (ND-8638)	49;0.5 (ND-10.4)	55;0.5 (ND-7.1)
FF	-	-	35;0.2 (ND-10.6)	36;0.1 (ND-0.9)
NF	-	-	27;0.2 (ND-0.5)	24;0.1 (ND-0.9)

**Conclusion:** These results confirm high CHA levels on dairy farms. Despite this no dairy farmers were sensitised to CHA. Selection out of dairy farming might be of importance.

**P4175****Fungal colonization of oxygen humidifier and nebulizer chambers**

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Humidified oxygen and nebulizers are routinely used in hospitalized patients suffering from respiratory ailments. These can however be potential source of allergens or infection if colonized by fungi. We undertook a study to determine if the oxygen humidifier chambers of portable cylinders and central lines at our hospital were colonized by fungi. The Hudson's chambers of nebulizers were also studied as they remain wet after use. Samples of these were obtained using sterile swabs on Tuesday as these chambers are usually cleaned on every Saturday. Spot samples were taken from ICUs, wards, casualty and OPD on a single day. Air samples were also obtained on the same day to determine if the fungal spore load in the inhaled room air was normal or high. 46/53 (86.79%) swabs from oxygen humidifiers and 7/17 (41.17%) swabs from Hudson's chambers grew fungi. There were a total of 14 species of fungi identified altogether. 4 of them are virulent strains and 6 are known allergens for asthmatics. The colonization was less in shallow Hudson's chambers (35.71%) as compared to the reusable long ones (66.66%). The air samples showed insignificant growth. The study indicates a potential in-hospital source of allergens and infection. The oxygen and nebulizer chambers need to be cleaned more frequently with disinfectants.

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**P4176****Prevalence of chronic obstructive pulmonary disease in male workers exposed to dust, gas and fume**Byung-Soon Choi, Joong Oh Lee, Youlim Lee. *Occupational Lung Diseases Institute, Occupational Lung Diseases Institute, Ansan, Gyeonggi-do, Korea*

**Purpose:** It is known that chronic obstructive pulmonary disease (COPD) can be developed after exposure to many kinds of dust, gas and fume. But the prevalence of COPD was not investigated extensively, especially after bronchodilator inhalation.

**Method:** Chest X-ray images were taken in 1,298 male workers exposed to many kinds of dust, gas and fume. Pulmonary function tests were done with short-acting bronchodilator during the periodic health examination from 2008 to 2010. Excluding the workers with the abnormal radiological findings that could affect lung function, the data of a total of 838 workers were analyzed.

**Result:** The prevalence of COPD increased with age: under age 45, 0.0%; 45 to 64, 31.6%; 65 to 74, 51.8%; 75 and over, 62.2% ( $p=0.000$ ). COPD was also prevalent in those with high relative exposure index, sum of multiplication of exposure level and exposure duration: under 60, 35.5%; 60 to 99, 37.2%; 100 and over, 47.2% ( $p=0.009$ ). About half of pneumoconiosis patients had COPD: 43.5% in profusion category 1; 49.6% in 2; 62.5% in 3, but the prevalence in profusion category 0/0 and 0/1 was also high, 30.1% and 30.8%, respectively. The prevalence of COPD in smokers was higher than non-smokers (31.8%), but there was no difference between ex- (41.7%) and current-smokers (41.5%). In ex- and current-smokers, it was 30.0% under 15 pack-years, 42.4% in 15 to 29, and 54.1% in 30 and over.

**Conclusion:** The prevalence of COPD was very high in workers exposed to many kinds of dust, gas, and fume occupationally. Also, it showed the increasing trend with exposure intensity.

**P4177****Occupational asthmogens and total IgE according to asthma status in the EGEA study**

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**Introduction:** The comprehension of the relationship between asthma and immunoglobulin E (IgE) remains a challenge. Several occupational asthmogens have been identified to cause or aggravate asthma, but their associations with IgE have rarely been studied.

**Aim:** To study the relationship between occupational exposure to asthmogens and total serum IgE in non-asthmatics, childhood-onset and adult-onset asthmatics.

**Methods:** Analyses were conducted in 1212 adults (aged 17-79 years, 48% men) from the Epidemiological study on the Genetics and Environment of Asthma (EGEA2, 2003-07) without missing data for work history and IgE. Lifetime exposure to asthmogens was estimated using an asthma-specific job-exposure matrix.

**Results:** 32%, 28% and 36% of non-asthmatics, childhood-onset and adult-onset asthmatics had respectively ever been exposed to asthmogens. In non-asthmatics, exposed subjects had a significantly lower total IgE level. In asthmatics, no association was observed. Nevertheless, among women with childhood-onset asthma, exposure to asthmogens was associated with higher IgE level (adjusted OR (95%CI) for IgE $\geq$ 100 IU/ml: 2.49 (1.07-5.83)).

	Total IgE, crude geometric mean (95% CI)		
	Non asthmatic (n=718)	Childhood-onset asthmatic (n=311)	Adult-onset asthmatic (n=183)
All	45 (3-685)	178 (12-2591)	98 (6-1585)
Occupational exposure			
Never exposed or exposed to low risk agents	49 (3-758)	170 (11-2756)	93 (6-1566)
Ever exposed to asthmogens	38 (3-539)	199 (18-2172)	108 (7-1633)
p	0.02	0.33	0.49
p adjusted for age, sex and smoking	0.01	0.48	0.89

**Conclusion:** Our results suggest a healthy worker effect among non-asthmatics. Further analyses will be conducted by distinguishing the types of asthmogens. Founded in part: AFSSET-EST-09-15

**P4178****Irritative effects of respirable particles and chromium in non-smoking welders**

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**Introduction:** Welding fumes are known to contain chromium (Cr) compounds. Particulate matter, Cr and other constituents of welding fume may induce inflammatory reactions.

**Aims and objectives:** We studied irritative effects of welding fume and Cr in non-smoking welders using spirometry and fractional exhaled nitric oxide (FeNO).

**Methods:** Shift exposure to respirable particles in the welding fume was measured with personal samplers in the breathing zone of 119 non-smoking welders. The Cr concentration in these fume samples was determined by inductively coupled plasma mass spectrometry. Post-shift spirometry was performed with pneumotachography. FeNO was determined with a handheld device (NIOX Mino®). A potential irritative effect of Cr and welding fume was evaluated with multiple regression models.

**Results:** Lung function measurements revealed normal average values standardized to European Community of Coal and Steel. (median of forced vital capacity (FVC): 111.2%; forced expiratory volume in on second (FEV1):104.7%; Tiffeneau index (FEV1/FVC): 77%). Median of FeNO was 17.5 ppb. Cr, respirable welding fume and use of dust masks together explained less than 10% of the variance of the variables under study. We found no effect of any of these potential predictors measured during a single working shift on FeNO or Tiffeneau index.

**Conclusion:** Our data analysis did not reveal an acute irritative effect of Cr and welding fumes in non-smoking welders assessed with spirometry and FeNO. Nevertheless, further investigations with the implementation of non-invasive methods to assess inflammatory processes in the upper airways are necessary to make final conclusions.

**P4179****Respiratory work disability and occupational outcomes in adults with asthma and bronchial hyperresponsiveness**

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**Background:** The correlation between asthma and work disability has been demonstrated in previous surveys. Changing job for respiratory problems often defines respiratory work disability. Little is known about occupations of asthmatics with respiratory work disability after they were forced to change job. This study investigates factors associated to respiratory work disability in asthmatics, focusing on occupational outcomes.

**Methods:** 342 adults in working age with asthma, diagnosed by GINA criteria and methacoline challenge or bronchodilator response, answered to a questionnaire. Subjects with occupational asthma were excluded. Respiratory work disability was defined as to have changed job/task because of asthma. Information about pulmonary function tests and skin prick tests were obtained from medical records.

**Results:** 22 subjects reported respiratory work disability. Age, sex, smoking, atopy, were not risk factors for changing work. Patients with work disability referred more often uncontrolled asthma (72.7% vs 60.5%), regular use of asthma controllers (81.1% vs 66.6%) and asthma relievers, even if these differences were not significant. Workers that have changed job because of asthma were still prone to work exacerbated asthma in the last year (81.8% vs 35.3%; OR 5.75, CI 95% 1.77-18.71) and work exacerbated rhinitis in the last year (61.9% vs 31.6%; OR 2.90, CI 95% 1.07-7.02), remaining exposed to known asthmogens (63.6% vs 54.1%).

**Conclusions:** In this study atopy did not predict job change. Maybe because the current economical situation, workers with respiratory work disability did not move to more safe occupations, remaining at risk of work exacerbated asthma.

**P4180****Enzyme immunoassay (EIA) for bacterial peptidoglycan (PGN) assessment in air and house dust samples**

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PGN forms the outer wall of Gram+ bacteria (Gm+B) and when liberated induces inflammation through TLR2 and NLR2. Thus, PGN is a potential marker for Gm+B. We employed 3 PGN standards, 3 monoclonal antibodies (mAb) and environmental samples to develop PGN-specific EIAs.

Reagents: anti-PGN mAb clones (B10, 6F6, 3C11); Ceramide  $\beta$ -D-galactoside, Kerasin and Phrenosin cerebroside for PGN capture; PGN standards: *Bacillus subtilis* (PGN-Bs), *Micrococcus luteus* (PGN-Ml) and *Staphylococcus aureus* (PGN-Sa). Evaluation methods: inhibition EIA, EIA with cerebroside for capture and PGN mAb for labeling, and double mAb sandwich EIA. Samples from three studies were extracted in PBS plus 0.05% tween.

Kerasin proved a higher affinity receptor than other cerebroside. The B10 and 3C11 mAb showed high specificity for PGN-Bs and PGN-Ml. The 6F6 mAb



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exhibited high specificity for all 3 PGN. Sandwich EIA did not provide suitable detection for the PGN perhaps because the mAb were directed toward the same epitope. Inhibition assays were inferior to the method employing cerebroside. Cerebroside effectively captured PGN for EIA. The 6F6 mAb bound to soluble (PGN-Sa) or insoluble (PGN-Bs; PGN-MI) macromolecular PGN while mAb B10 and 3C11 bound preferentially to insoluble (PGN-Bs; PGN-MI) PGN. House dust samples had mean ( $\pm$ SE) PGN levels of  $34.45 \pm 4.70 \mu\text{g}/\text{mg}$  dust. Inhalable-fraction air samples averaged  $7.52 \pm 2.90 \mu\text{g}/\text{m}^3$  while EDC passive air samplers averaged  $2740 \pm 680 \mu\text{g}/\text{m}^2$  PGN.

These data show that our antibodies bind to an epitope on the PGN backbone that is common to many Gm+B. The sensitivity of the cerebroside-mAb EIA is sufficient for quantitation of PGN in household dust and air samples.

#### P4181

##### Characterization of airborne organic dust exposure with limulus amoebocyte lysate – Test and whole blood assay

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The aim of the study was to evaluate if measurement of endotoxin and/or pyrogenic activity are suitable methods to describe different exposure circumstances for example in composting plants. Dust sampling was performed with stationary pumps. Fiberglass filters were extracted with PBS. Endotoxin activity was determined with Limulus amoebocyte lysate (LAL)-assay (Charles River, Sulzfeld). Pyrogenic activity was measured with a whole blood assay (WBA) using cryo-preserved blood (Zwiler Laboratorium, Konstanz) measuring Interleukin (IL)-1 $\beta$  release with a specific ELISA in the cell-free supernatant. In all 124 filter extracts endotoxin as well as pyrogenic activity were detectable. Median of endotoxin activity was  $12 \text{ EU}/\text{m}^3$  (range 6 - 3421). Median of pyrogenic activity was  $3831 \text{ PU}_{\text{IL-1}\beta}/\text{m}^3$  (pyrogenic unit;  $1 \text{ PU}_{\text{IL-1}\beta} = 1 \text{ pg/ml IL-1}\beta$  release; range 2126 - 124590). Correlation between LAL-assay and WBA was  $r = 0.78$  (Pearson). Dust samples collected in wheel loaders ( $n = 33$ ) showed median values of  $9 \text{ EU}/\text{m}^3$  and  $3580 \text{ PU}_{\text{IL-1}\beta}/\text{m}^3$ , respectively whereas in the area of sieving machines ( $n = 14$ ) a median of  $61 \text{ EU}/\text{m}^3$  and  $7608 \text{ PU}_{\text{IL-1}\beta}/\text{m}^3$  was measured. Test results of WBA and LAL assay were compared with receiver operating characteristic (ROC) curve using LAL-Test as gold standard. Presuming a desirable test sensitivity of 95% WBA provides a possible specificity of 40% for a cut-off of  $10 \text{ EU}/\text{m}^3$  increasing to 100% specificity if the cut-off was set at  $500 \text{ EU}/\text{m}^3$  (test efficiency 97.5%). LAL-Test and WBA are applicable methods to evaluate bioaerosol exposure. Especially in areas with lower endotoxin activity and with further pyrogenic components WBA may deliver additional information.

#### P4182

##### Bioactivity of <sup>14</sup>C-labeled endotoxin in aggregates, shed blebs and whole bacteria: Potency comparison in the LAL assay, cell cultures, and mouse bioassays

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It is unknown if endotoxin reactivity in the LAL assay varies by its presentation or if this parallels differences in potency *in vitro* and *in vivo*. We compared endotoxin responses in the LAL assay, in cell cultures and *in vivo* when presented in different forms.

Lipooligosaccharide (LOS) from *Neisseria meningitidis* sero B was metabolically labeled and incorporated into intact bacteria, purified membrane blebs, and aggregates (<sup>14</sup>C-LOSagg). <sup>14</sup>C-LOS content of each was quantified as LOS-specific <sup>14</sup>C-3-OH fatty acids. Equivalent escalating doses of <sup>14</sup>C-LOS-containing bacteria, blebs, or LOSagg were tested in the LAL assay, *in vivo* in C3HeB/FeJ mice following intranasal instillation (monitoring induced airway inflammation), and *in vitro* using HEK293 cells  $\pm$  CD14, MD-2, TLR4 (monitoring extracellular accumulation of IL-8). Doses of <sup>14</sup>C-LOS were measured by scintillation counting (our gold standard).

Potency varied depending on LOS presentation. Ranked reactivity was: in the LAL assay, blebs > LOSagg > bacteria; by airway inflammation, bacteria > blebs > LOSagg; by activation of HEK cells, LOSagg > blebs > bacteria. Differences in potency reached 10-fold for *in vitro* and *in vivo* inflammation. Across the range of doses, the ratio of LOS concentration determined by the LAL assay to the gold standard was 1.0-1.3 for blebs, 0.3-0.7 for aggregates and 0.1-0.2 for whole bacteria.

How endotoxin is presented significantly affects endotoxin reactivity in the LAL, cell culture and whole animal assays. Compared to the gold standard measure, the LAL assay substantially underestimated the content of the LOS preparations for LOSagg and bacteria.

#### P4183

##### COPD causation and workplace exposures; an assessment of annual FEV<sub>1</sub> decline significance between expert clinical raters

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**Objectives:** Epidemiological studies identify that 10-15% of the burden of chronic obstructive pulmonary disease (COPD) is attributable to inhaled occupational exposures. Despite this knowledge, very little is known about how clinicians weight this contribution against other risks.

**Methods:** 15 hypothetical cases of COPD were structured to represent a broad range of smoking and occupational exposure histories. Twelve clinical experts in COPD and 12 clinical experts in occupational lung disease (OLD) were invited to rate the causes of COPD in each case. Cases were developed *a priori* into 9 categories; combinations of low, medium and high tobacco smoking and low, medium, and high COPD-risk occupational exposures. Five cases also contained annual FEV<sub>1</sub> decline data, and raters were asked to comment about its significance, and any required actions. These latter five cases represented annual FEV<sub>1</sub> declines of between 95mls to 400mls a year.

**Results:** Responses were received from 14 raters (9 OLD and 5 COPD), representing a 58% response. Significant variation was seen when assessing the relevance of various declines in FEV<sub>1</sub>. In particular, there were differences in approach to identifying significant or concerning decline, and similarly different advice concerning the risks of continuing employment.

**Conclusion:** There was a wide range of estimates relating to causative factors in COPD documented by experienced clinical raters, and a variance of view relating to annual decline in FEV<sub>1</sub>. An improved evidence base is required to help formulate practical guidance for respiratory and occupational physicians when interpreting serial measures of lung function in working groups.

#### P4184

##### Respiratory symptoms, lung function tests and bronchial hyperresponsiveness among workers in petroleum industry

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**Objective:** To determine the prevalence of respiratory symptoms, lung function test abnormalities and non specific bronchial hyperresponsiveness (BHR) among workers employed in petroleum refinery.

**Methods:** A cross sectional study was performed including 45 males (mean age=41.0 $\pm$ 8.6) employed in crude oil refinery (duration of exposure 15.2 $\pm$ 6.8) and 40 male office workers as a control group (mean age=40.6 $\pm$ 7.5) matched for age, smoking habits and socioeconomic status. Evaluation of examined subjects included completion of a questionnaire on respiratory symptoms in the last 12 months (cough, phlegm, dyspnea, wheezing, and chest tightness), spirometry and histamine challenge (PC20 $\leq$ 8 mg/mL).

**Results:** Refinery workers had a significantly higher prevalence of cough with phlegm (31.3%), dry-cough (18.1%), wheezing (11.4%), dyspnea (4.1%), and nasal symptoms (8.3%) than the control group ( $p < 0.05$ ). All spirometric parameters (FVC, FEV<sub>1</sub>, FEV<sub>1</sub>/FVC%, MEF75-25, MEF50, and MEF25) were lower in petroleum refinery workers compared with the control group, but statistical significance was found for MEF25, MEF50, and MEF75 ( $p = 0.03$ ,  $p = 0.02$ , and  $p = 0.007$ ; respectively). The prevalence of non specific BHR, defined by histamine PC20 less than 8 mg/mL, was higher in petroleum refinery workers but statistical significance was still not reached (21.7% vs. 14.7%).

**Conclusion:** Our study suggest that occupational exposure in the petroleum industry is associated with a higher prevalence of respiratory and nasal symptoms, lung function impairment and higher prevalence of non specific airway responsiveness.

#### P4185

##### Dust exposure and respiratory symptoms; cross sectional study in Tanzanian coffee factories

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**Introduction:** Exposure to coffee dust is associated with respiratory symptoms among workers in secondary coffee processing in industrialized countries, but only three studies have been done in primary coffee factories and none of these studies were in Tanzania.

**Aim:** This study was carried out to examine whether there is a relationship between total dust exposure and respiratory health effects among workers in Tanzanian primary coffee processing factories.

**Methods:** A cross sectional study was conducted in two primary coffee factories and in a beverage factory which served as control. Total dust samples were collected throughout the working shift from the breathing zone of the workers in the coffee factory ( $n = 44$ ) and the control factory ( $n = 19$ ). Respiratory symptoms were

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assessed by standardized ATS questionnaire. Statistical differences were tested by Independent t test and Chi Square. Logistic regression analyses were performed, adjusting for age and smoking.

**Results:** Totally 150 workers participated; 79 coffee workers and 71 controls. Coffee workers had significantly higher prevalence than the controls for morning cough with sputum (23% vs. 10%, OR = 2.9 95% CI 1.1 - 8.4) and chest tightness (27% vs. 13%, OR = 3.2 95% CI 1.2 - 8.7). Total dust exposure in the coffee factories was significantly higher than in the control factory (geometric mean; 1.23 mg/m<sup>3</sup> vs. 0.21 mg/m<sup>3</sup>, p = 0.001).

**Conclusion:** Coffee workers in primary factories have higher prevalence for respiratory symptoms and higher dust levels than controls.

#### P4186

##### The investigation of stable nitric oxide (NO) metabolites correlation in exhaled breath condensate (EBC) in Chernobyl clean-up workers (CCUW) with COPD

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The aim of the study was to investigate the correlation between stable NO metabolites in EBC in CCUW with COPD during the course of antioxidant inhalation.

**Materials and methods:** 58 males outpatients were enrolled in the study. Group1 contains 21 patients CCUW with COPD stage I; group2 contains 19 patients CCUW with COPD stage II. The control group consisted of 18 healthy volunteers. The EBC was collected in all patients, as well as the TNN concentration in EBC was measured before and after the course of therapy. The nebulized ambroxol inhalation (15 mg BID) was carried during 7 days in addition to traditional COPD therapy. The TNN concentration as well as NO<sub>3</sub>-/NO<sub>2</sub>- concentrations were measured by spectrophotometric method using the Griess reaction. The correlation between NO<sub>3</sub>-/NO<sub>2</sub>-concentration in EBC during the course of antioxidant inhalation was also investigated.

**Results:** The results obtained demonstrate the statistically significant increase of NO<sub>3</sub>- concentration and NO<sub>2</sub>- concentration in EBC in both groups compared with control. The strong positive correlation between observed parameters (r=0.98; p=0.001) as well as linear coefficient k=2.13 (k=[NO<sub>3</sub>-]/[NO<sub>2</sub>-]) were determined only in control group. There was a statistically significant correlation between NO<sub>3</sub>- and NO<sub>2</sub>- levels in EBC in group1 after the course of ambroxol admission (r=0.89, p=0.003 with k=2.7).

**Conclusion:** The correlation revealed indicates positive changes in NO metabolism. Thereby, the investigation of NO<sub>3</sub>-/NO<sub>2</sub>- correlation in EBC in patients with COPD can be used as a marker of the efficacy of the therapy admitted.

#### P4187

##### Biotoxicological pattern and related respiratory impairments in chemical laboratory workers

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**Aim:** To evaluate the relations between the changes in blood/urine markers and respiratory outcomes in workers from a chemical research institute

**Material/Methods:** 161 workers (73% women, 23% smokers, having mean age 44.6±13 yrs; mean exposure 20.8±14 yrs) were investigated by spirometry, blood/urine biomarkers, including exposure/effect ones. Workplace air solvents level was below upper threshold limits, but noxious cumulative index varied between 1 and 2.

**Results:** Urinary total phenols releases correlated with TBARS (r=0.22; p<0.01). 22% of subjects had mild respiratory changes (discrete distal obstructive syndrome). In the group of 95 subjects having >10 yrs length of exposure, SOD correlated with Ig M level (r=0.20; p<0.05), and urinary acetone with IgM, resp. IgG ((r=0.19; p<0.05), showing the relation of the inflammatory effects resp. oxidative imbalance with the occupational hazards.  $\frac{3}{4}$  of the subjects diagnosed with spirometric changes were in this subgroup, but these changes did not correlate with smoking habit.

**Conclusions:** Immunological and oxidative stress markers might be related to respiratory changes, even in the early stage of occupational-induced respiratory diseases.

#### P4188

##### Occupational allergy in apprentices hairdressers and hairdressers in region of Lodz, Poland

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Hairdressers are exposed to various chemical factors and agents that cause occupational respiratory and skin diseases.

**Aim:** The aim of the study was to assess the prevalence and risk factors of occupational allergy in apprentices hairdressers and hairdressers from the region of Lodz in Poland.

**Material and methods:** Prospective study was done in apprentices. A group of apprentices hairdressers were tested twice (34 at the beginning of education and 21 at the end) for respiratory and skin allergy. 54 hairdressers were tested for respiratory and 40 for skin allergy.

**Results:** The prevalence of respiratory symptoms in apprentices after two years at school was not significantly higher after 2 years of education. One student became sensitized to latex. Positive skin prick tests to common allergens was a risk factor of rhinitis related to work in apprentices hairdressers OR = 9,75 (CI 1,03 – 14,64). Prevalence of cough, dyspnoe and rhinitis was significantly higher in hairdressers than apprentices in the 1st class (p<0,05). Smoking was a risk factor of dyspnoe OR=2,37 (95%CI 1,07-5,28) and rhinitis OR=2,44 (95%CI 1,1-5,3) in hairdressers. Two of 54 hairdressers was sensitized to ammonium persulfate and one to para-phenylenediamine. One subject had an occupational asthma diagnosis.

Contact allergy was common in hairdressers and apprentices, however more prevalent in the first group.

##### Conclusions:

- Respiratory symptoms were not the most important health problem in apprentices hairdressers at the end of education probably due to "healthy worker effect".
- Hypersensitivity to common allergens in apprentices and smoking in hairdressers were risk factors of respiratory symptoms.