

10141- EXPOSURE ASSESSMENT TO LEAD AND ARSENIC

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Objectives. The pollution with heavy metals made by the metallurgical plants represents a major health problem. Lead and arsenic are the main pollutants with toxic effects on the human organism. In lead and arsenic-related industries, workers not only may inhale lead and arsenic dust and lead oxide fumes, but may eat, drink and smoke in or near contaminated areas, increasing the probability of lead and arsenic ingestion. The monitoring of lead and arsenic exposure is necessary because they may alter the organism reactivity, increase the sensitivity for the pathogen agents, stress and other noxes and so generate a varied pathology with long recovery.

We investigated a group of lead and arsenic exposed workers, from a non-ferrous metallurgical plant, and evaluated the professional risk according to the biotoxicological parameters, clinical pathology and noxes' concentration in the working environment.

Methods. Eighty workers from the "melting" sector were tested for blood lead and urine arsenic, using the atomic absorption spectrophotometry and the chemical method with silver diethyldithiocarbamate. The workers mean age was 35.1 ± 10.9 years and their mean time of exposure was 16.2 ± 9.0 years.

Clinical examinations and specific questionnaires regarding the long-term exposure to high levels of lead and arsenic were completed.

Working environment monitoring showed normal values for lead and high values for arsenic.

Results. We found: high blood lead values in 42.5% of workers (group 1); high urine arsenic values in 50% of workers (group 2); both high blood lead and urine arsenic values in 30% of workers (group 3).

Regarding the clinical symptomatology: the asthenovegetative syndrome: 35.3% workers in group 1, 35% workers in group 2 and 83.3% workers in group 3. The dyspeptic syndrome: 11.7% in group 1, 15% in group 2 and 33.3% in group 3. The pseudoreumatic syndrome: 29.4% in group 1, 20% in group 2 and 41.6% in group 3. Arms and legs paresthesias: 17.6% in group 1, 25% in group 2 and 58.3% in group 3.

The asthenic, dyspeptic and pseudoreumatic syndromes which could be correlated with lead exposure, were found in 40% workers from group 1. The asthenovegetative syndrome, gastrointestinal phenomena and paresthesias, typical for arsenic intoxication were found in 37.5% workers from group 2. The asthenic, dyspeptic, pseudoreumatic syndromes and legs and arms paresthesias were found in 65% of the workers from group 3.

Conclusion. These data establish possible relations between the levels of lead and arsenic in organism, the length of exposure and the characteristic symptoms for these exposures. The workers with high biotoxicological values require measures for decreasing the lead and arsenic concentrations in the working environment, the strictly use of the protective means and measures for disease prevention.

10230- The Influence of Milk Intake on the Lead Toxicity to the Sensory Nervous System in Taiwan Lead Workers.

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Abstract

The peripheral nervous system is one of the target organs in lead intoxication. For the health of lead workers and prevention of lead-induced adverse effects, nutritional support was traditionally considered as a method, especially calcium supplement in diet. The goal of this study is to evaluate the interactive effects of calcium in milk and lead on the peripheral nervous system in workers with long-term lead exposure. We measured 181 workers' current perception thresholds (CPT) and 144 vibration perception thresholds (VPT) as neurological outcomes. The outcome variable was correlated to the subject's amount of milk intake and blood lead levels and index of long-term lead exposure that was calculated by the subject's serial blood lead data in a period of working duration. The potential confounders, including age, body height, smoking and alcohol consumption, were also collected and analyzed in multiple regression models. The results showed 23 workers with lactose intolerance, which meant that they have suffered from diarrhea or abdomen discomfort after drinking milk since childhood, had higher blood lead parameters, and higher thresholds in quantitative sensory nerve tests, especially, statistically significance on 5 Hz and 250 Hz of hand CPTs. In multiple regression models with control potential confounders, significant protective effects of milk intake were found on reducing hand CPTs, but not on foot CPTs. In conclusion, our study, using measurement of sensory nerve function, revealed that drinking milk (more than 700 ml/day, about 2 bottles a day) might have an effect to protect lead neurotoxicity by way of mechanisms, such as decrement of lead intestinal absorption, receptor or calcium channel complete.

Keywords : lead, peripheral nervous system, milk intake

10261- Familial Aggregation of Blood Lead Levels

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We studied the correlation of blood lead levels among household members in an urban area of Seoul, Korea.

The study subjects comprised 177 children, 255 fathers and 206 mothers from 308 families with 2 or more members. We analyzed the blood lead levels using induced coupled plasma/mass spectroscopy. Correlation analysis and regression modeling were performed to assess the aggregation of lead exposure patterns within the family.

The mean blood lead level of children was 2.23 μ g/dL, boys' being 2.38 μ g/dL and girls' was 2.06 μ g/dL. The mean levels were 3.11 μ g/dL for fathers and 2.33 μ g/dL for mothers. The correlation of log-transformed blood lead levels between household members were 0.20(father-children), 0.23(mother-father), 0.35(mother-child) respectively. Regression modeling showed that fathers' and mothers' blood lead levels were independently associated with their children's levels, adjusting for children's age and sex. Mothers' lead levels, compared to fathers', showed a stronger association with the children's blood lead levels.

We concluded that there was a positive association of blood lead levels between parents and children. Considering that the association becomes stronger in the order of father-child, father-mother, mother-child, the major source of children's blood lead in this population appears to be from their home environment.

10265- LONG-TERM USE OF CHEWING GUM AND MERCURY EXPOSURE

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In experimental studies, chewing gum has been shown to increase the release rate of mercury vapour from dental amalgam fillings. In 1996 we reported that frequent use of nicotine chewing gum resulted in an increased mercury burden in subjects with amalgam fillings (Sällsten et al. J Dent Res 1996;75:594-8). The aim of this study was to investigate whether this is the case also for subjects who regularly use ordinary chewing gum.

Methods. Mercury levels in plasma (P-Hg), urine (U-Hg) and end-exhaled air (Alv-Hg) were examined in 17 chewers, using ordinary chewing gum for at least three hours per day, and in 15 referents. The release rate of mercury from the amalgams was also determined. The chewers were recruited by ads in a newspaper. Age and numbers of amalgam fillings were similar in the two groups. Mercury levels in biological media were determined using the atomic fluorescence technique. The release rate of mercury was determined in intra-oral air using a gold film mercury analyzer.

Results. The P-Hg, U-Hg and Alv-Hg levels were significantly higher in the chewers than in the referents. In plasma the median level was twice as high and in urine and end-exhaled air the levels were three times higher. The median estimated chewing time for the chewers was 5 hours/day. The release rates of mercury (basal and stimulated) from the amalgams were similar in the two groups. In both groups, P-Hg, U-Hg and Alv-Hg were significantly correlated with the number of amalgam surfaces.

Conclusion. Frequent use of chewing gum in people with amalgam fillings increases the uptake of mercury.

10295- EFFECTS OF THE LEAD AND ARSENIC ON THE NERVOUS SYSTEM IN OCCUPATIONAL EXPOSURE

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Introduction and Objectives In industrial environment in nonferrous metalurgic areas, humans have exposed to the simultaneous actions of many metals. It is well known that duration from onset of exposure to the development of clinically observable disease depends much on the intensity of exposure. At low occupational exposure levels it can take years until clinical symptoms appear and at higher levels of exposure, accumulation of toxic blood metals levels associated with clinical symptoms may occur within days or weeks. Lead and arsenic can induce significant disruption of various neurotransmitters, including dopamine, norepinephrine, γ -aminobutyric acid and serotonin. The relationship of these neurochemical alterations to the manifestation of central nervous system dysfunction in exposed humans is unclear at the present time. Interference with neurotransmitter systems appear to be associated with behavioral disturbances and the clinical expression of these findings was suggested by hyperactivity.

Materials and methods We investigated 240 workers from a metallurgical plant with the mean – age = $38,40 \pm 7,80$ years and the mean –time of exposure = $12,45 \pm 8,67$ years. We made clinical, neurological, psychological, hematological and biotoxicological (lead blood levels, urinary delta-aminolevulinic acid, urinary arsenic) investigations. In addition symptoms and psychologic questionnaires were completed.

Results From 244 workers, 30 subjects (12 %) had chronic saturnism; 7 subjects (3%) had high lead absorbtion; 19 subjects (7,79%) had arsenic chronic poisoning ; 17 workers from them had clinical sensityve polyneuropathy with a simetrical stoking-and-glove distribution (paresthesias, hyperstesias, pains) EMG on ulnar and sciatic popliteal externe nerves showed a delayed motor conduction velocity in 6 cases.

Symptoms related to the nervous system were more subtle and nonspecific. These symptoms are included in neurasthenic syndrom (headache (61,7%) , dizziness (64%, sleeping disorders (48%) , memory deficit (41%), decrease of the concentrate attention ability (57%), learning ability (27%), depression (13%), somnolence (43%), anxiety (14%), and changes in personality such as increased irritability, 33(%), diminished libido and sexual dysfunctions (35%), affectivity disorders (5,7%).

Discussion The results of this study pointed out subtle signs of nervous system damage in workers long exposed to relatively low levels of lead and arsenic. Nerve conduction velocity was found to be abnormal in a group of workers with significant arsenic exposure, but without manifestation of arsenic neuropathy. Abnormalities of nerve conduction velocity and an insidious distal symetric sensory neuropathy of the hands and feet were correlated with concentration of arsenic in the urine. The psychological examinations pointed out personality alteration of the workers with significant metals exposure.

Conclusions The psychological investigation may be a important instrument in evaluation of the cause-effect relation in occupational exposure to the neurotoxicants. The investigation of the nervous system and behavior may be a useful model for the assesement of the adverse effects and for the identification of the nondengerous exposure levels.

10414- Cadmium exposure and distal forearm fractures

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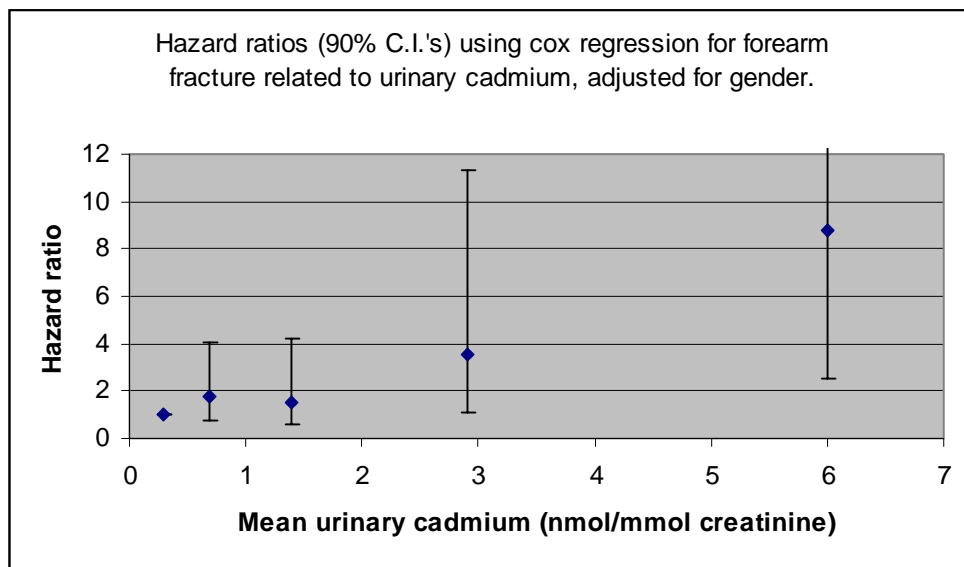
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Fractures due to osteoporosis are a worldwide problem and the incidence is rapidly increasing. One third of the fractures related to osteoporosis occur in the arm, most often in the forearm. These fractures result in only a modest increase in morbidity compared to hip fractures, but cause a lot of pain for the individual and account for considerable health care costs. Cadmium is known to cause renal damage and affect the bone. The aim of this study was to analyse the relationship between cadmium exposure and forearm fractures. 479 men and 542 women aged 16-81 years, environmentally or occupationally exposed to cadmium, living in the southeast of Sweden close to battery factories that have been producing cadmium nickel batteries, were included in the study. Cadmium was measured in urine, using inductively coupled plasma mass spectrometry (ICP-MS), and used as a marker for the cadmium body burden. Information about fractures and other risk factors for fractures were obtained from questionnaires. The fractures were then validated from medical records. The association between cadmium dose and risk of forearm fracture was examined using Cox proportional hazard regression analysis. Cadmium did not affect the fracture risk for the part of the study population aged less than 50 years. For the population older than 50 years the fracture hazard ratio increased by 18% (C.I. 2% to 38%) per nmol cadmium /mmol creatinine, adjusting for gender, occupational exposure, weight, smoking and calcium-intake.

Analyses where subjects were grouped in categories of cadmium in urine also showed an increased fracture risk with increasing cadmium levels, as can be seen in the figure. The hazard ratios reaching 8.9 (C.I. 2.6, 30) in the highest exposure category (u-Cd > 4 nmol/mmol creatinine, mean 6.0). These results indicate that cadmium exposure increases the risk for forearm fractures.



10458- HEPATIC DEPOSITION OF BUTYLTIN IN HUMANS

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Health effects following exposure to butyltin compounds have focussed on effects on the immune system, but endocrine effects of butyltin have been documented in a variety of marine species. The information on human exposure to butyltin compounds and hepatic deposition is limited. Intake of marine food is the main source of butyltin exposure to humans and recent data indicate that butyltin concentrations in marine food may exceed 400 ng/g. The present study includes 18 consecutively sampled human livers analysed for butyltin compounds. Dibutyltin (DBT) concentrations varied between 0.8 ng/g and 28.3 ng/g with a mean concentration of 9.0 ng/g. Significantly lower concentrations of mono butyltin (MBT) was observed ranging from 0.3 ng/g to 4.7 ng/g with a mean value of 1.6 ng/g. Age and DBT/MBT ratio were significantly associated. We conclude that younger men have more recent exposures or have a lower capacity to debutylate DBT than older men and would therefore potentially be more susceptible to butyltin toxicity. Given the inter-person variability observed in our limited group of men, we can not exclude that thresholds for either immunotoxicity or effects on the endocrine system may occur due to exposure to butyltin compounds alone or in combination with other environmental toxicants with similar target organs.

10510- Independent and Modifying Effects of Lead Exposure on Mini-Mental Status Exam Scores in Elderly Men.

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Objective: Lead exposure may be a risk factor for dementia among elderly subjects.

Methods: Mini-mental status exam scores (MMSE) were measured among 1033 Normative Aging Study Subjects (NAS). Of whom 752 had data on patella lead concentration and 1031 had data on blood lead concentration. Multiple linear regression and logistic regression analyses were performed using MMSE as the dependent variable, patella or blood lead as the exposure of interest, and age, education and alcohol intake as covariates. For the logistic regression analysis, MMSE was dichotomized at scores of ≥ 24 vs 23 or less, a standard cutpoint when screening for dementia. To examine interactions between age and lead exposure, linear regression models were constructed with interaction terms for lead biomarker level*age (patella or blood lead levels in separate models) to determine effect modification. Models were also stratified by quartiles of blood or patella lead levels and the beta coefficients for age in predicting MMSE score compared. **Results:** Both increased blood and bone lead levels were associated with increased risk of dementia. The difference between means of the lowest and highest quartiles of patella lead levels was associated with an increased risk (OR = 2.1; 95% CI: 1.1 to 4.1) of dementia. For blood lead the change from the means of the lowest to highest blood lead quartiles was associated with an OR of 3.4 (95% CI 1.6 to 6.2) in predicting dementia. We also found evidence of effect modification between lead biomarkers and age. Among subjects in the lowest quartile of patellar lead, the linear regression beta coefficient for age predicting MMSE was -0.03 (95% CI -0.06 to 0.008), while in the highest quartile of patella lead the beta coefficient for age was -0.13 (95% CI -0.19 to -0.07). For blood lead the beta coefficient for age in predicting MMSE score in the lowest quartile of blood lead was -0.04 (95% CI -0.07 to -0.02), and in the highest quartile of blood lead was -0.09 (95% CI -0.13 to -0.06). The p value for the interaction terms of the previously described patella and blood lead interactions with age were both <0.05 . **Conclusions:** Increased patella/blood lead levels are associated with increased risk of dementia among elderly men. Lead exposure modifies the decline in cognition associated with age such that subjects in the highest quartiles of lead exposure have a steeper rate of decline in MMSE scores with increasing age compared to subjects in the lowest quartile of patella/blood lead levels. These results suggest that lead exposure may play a causative role in diseases of neurodegeneration among the elderly. Longitudinal studies using repeated MMSE scores are needed to confirm that lead exposure accelerates cognitive decline associated with advancing age.

10595- Blood cadmium concentrations and risk of prostate cancer
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Cadmium is a heavy metal widely distributed in the environment, and is a potentially toxic element that can accumulate in human tissues. Within a case-control study evaluating prostate cancer risk and several factors, this analysis determined risk associated with cadmium concentrations in whole blood. 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 blood. After biopsy of the 239 eligible and consenting subjects, 79 were diagnosed with incident primary prostate cancer. The remainder (n=160) had a variety of benign 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=195), for a total of 330 controls. Most factors such as age, body mass and lifestyle variables are similar for cases and controls. Among cases, 67% have a level of cadmium below the detection limit, and among controls this is true for 57.3%. Mean concentrations in the 50th, 75th and 90th percentiles are 2.5µg/L, 4.0µg/L, and 7.3µg/L for cases, and 0.6µg/L, 2.2µg/L, and 3.9µg/L for controls. Adjusted for age and physical activity as a teen, statistically significant increased risk is evident (odds ratio=1.17; 95% confidence interval: 1.01-1.34). These findings suggest that higher cadmium concentration in blood may be associated with prostate cancer risk.

10606- Air pollution and children's exposure to lead and cadmium in a smelter region
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This study was performed in a region of a smelter plant in Bulgaria producing lead, cadmium, other non-ferrous metals and hard alloys. Such productions are known as potent emission sources of particulate matter, sulfur dioxide, and airborne lead, cadmium, and other heavy metals. The presence of such a source of hazardous emissions with a potential human health risk required exposure assessment of the population in the area.

The present study involved assessment of a) external exposure of the general population in the area by monitoring ambient air levels of lead and cadmium; b) children's internal exposure by measuring blood lead levels in a group of children aged 11-12; and c) maternal-infant exposure by measuring lead levels in the placenta, maternal blood and cord blood at birth. Ambient air samples were collected at three fixed monitoring stations in residential areas in the vicinity of the plant. Determination of lead and cadmium in air samples and of lead in blood and placenta was performed by atomic absorption spectrometry. Comparisons were made with an area free from industrial metallurgical emissions. It was found that ambient air was contaminated with lead and cadmium at levels above the maximum acceptable limits. Significantly higher levels of blood lead and cadmium were found in the local children population in comparison to children of the same age from a non-industrial area. The sampling of maternal-infant pairs from the region revealed elevated lead in the cord blood, maternal blood, and placenta that was associated with adverse birth outcomes and prematurity. The results of this study show that the heavy metal pollution in the region resulted in elevated biological exposure to lead and cadmium in local children and newborns that was associated with adverse health effects.

10641- Dietary calcium as a potential modifier of the relationship of lead burden to blood pressure: The Normative Aging Study.

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Background. Elevated body lead burden and low dietary calcium intake have been independently associated with an increased risk of hypertension in separate bodies of studies. In this investigation we measured both lead burden and calcium intake and tested the hypothesis that the relationship of lead burden to hypertension and blood pressure is modified by dietary calcium intake.

Methods Four hundred seventy one men from the Normative Age study (NAS), mean (SD) age of 66.5(7.1), were eligible for this study. Blood lead was measured using graphite furnace atomic absorption spectroscopy and bone lead was measured by K-X-ray fluorescence (KXRF). Each subject filled out a self-administered medical and family history questionnaire and a validated semi-quantitative food frequency questionnaire.

Results Using a dietary calcium intake of 800mg/day as a cut-off point, 259 subjects (55%) were classified as having low calcium intake and 212 (45%) subjects were classified as having high calcium intake. In logistic regression models stratified by dietary calcium intake, tibia lead was a significant predictor for having developed hypertension amongst subjects with low dietary calcium intake (β -coefficient = 1.024; 95% confidence interval, 1.003 to 1.05) but not amongst subjects with high dietary calcium intake (β -coefficient = 1.006; 95% confidence interval, 0.970 to 1.042). Similar differences in the odds of developing hypertension by dietary calcium intake status were seen with respect to the effect estimates associated with age and body mass index. In a model of all subjects, tibia bone lead remained independently and significantly associated with risk of hypertension, dietary calcium was not significantly associated with risk of hypertension, and an interaction term of bone lead with dietary calcium was borderline significant ($p < 0.15$).

Conclusion We found that high bone lead levels increase the odds of developing hypertension with an effect that was most striking amongst individuals with low dietary calcium intake. The role of dietary calcium intake in modifying the response of blood pressure to lead burden may offer important avenues for treatment and secondary prevention. Given the wide prevalence of elevated lead burden in middle-aged and elderly populations of the US, more research is warranted on this topic.

10647- Procedure Supply of Heavy Metals Control in Biological Media Using Atomic Absorption Analysis

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Procedure supply of heavy metals control in biological media is one of the main problems during monitoring of trace elements dysbalance in organism. Due to its analytical possibilities (selectiveness, detection range 0.002-30 $\mu\text{g/ml}$) and metrological characteristics (reproductiveness, accuracy up to 25%), atomic absorption spectrophotometry is the most reliable method for metal identification in different objects including biological materials. Flame atomic absorption exceeds usual chemical methods (titrimetric, spectrophotometric, electrochemical) in productivity of labor, rate and costs of great batch analysis of similar assays. Electrothermic analysis is also most suitable for monitoring studies. One of the urgent problems of atomic absorption with flame atomization is identification sensitivity increase of some elements (Pb, Cr, Mn, Cd, etc) in biological media. For flame variant of the method this problem was solved and new procedures of biological media assay preparing were developed. Due to these procedures, identification of more elements, low ranges of some component detection and satisfactory metrologic characteristics became available. Procedures of manganese, lead, cadmium, nickel, zinc, copper, chromium and ferrum identification were developed. These procedures use direct element evaluation of liquid media (urine, bile and gastric juice) with detection sensitivity 1×10^{-1} - 1×10^{-3} $\mu\text{g/ml}$ and maximum error 19.5%; it also uses methods of biological material transfer to study solution that perfectly combine thermic decomposition and acidic mineralization for blood, hair, placenta, meconium and breast milk analysis with maximum detection error 18.9%. Procedures for heavy metals detection, approved by Russian Health Ministry, are included to the collection of procedure directions "Chemical Compounds Identification in Biological Media" and are recommended for practical use by Russian State Sanitary Epidemiological Surveillance agencies, and clinical and scientific institutions. Thus, development of new suitable procedures for biological materials analysis allowed use flame atomic absorption as high-effective method of heavy metals control in biological media during monitoring studies.

10692- Excess Risk of Kidney Disease in a Population Living Near Chemical Installations
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In collaboration with the North Cheshire Health Authority, the Small Area Health Statistics Unit (SAHSU) undertook some preliminary investigations into the population's health in the vicinity of a large chemical complex in Runcorn. Emissions data for 1993-2000 revealed that large amounts of chemicals were emitted from several sites in the Runcorn area. For example, 3096 tons trichloroethylene, 1625 tons chloroethene, 730 tons chloroform, 14 tons mercury, and over a ton each of lead and chromium were emitted as well as lesser quantities of arsenic, cadmium and hexachlorobutadine. All these substances have toxic effects on a range of human organs, several of them affecting the kidneys. The aim of the study was to determine if there was an increased incidence of kidney disease near the industrial installations as, were this found to be the case, such an observation would suggest a link to emissions. Standardised Mortality Ratios (SMRs) were calculated for the years 1981-1999 for areas 0-2km and 2.01-7.5km from the installations (populations 366,500 and 3,038,044 person years respectively). Expected figures were derived from the North West region population. There was an excess risk of deaths from nephritis, nephrotic syndrome and nephrosis, based on 233 observed deaths. SMRs in the 0-2km area were 152 (95% CI 88-243) in males and 142 (84-224) in females; and in the 2.01-7.5km area, 108 (86-135) in males and 128 (107-153) in females, consistent with an exposure-response effect, although confidence intervals do overlap. The Health Authority also investigated, at electoral ward level, renal disease using routinely collected hospital admissions data. These data were available from 1990 to 1999, and were used to calculate district age standardised renal disease ratios (ASRDR) . When these results were mapped across the district, it was found that the rate of renal disease was elevated in Runcorn and Widnes with ASRDR's of 128 (95% CI 119-138) and 121 (110-132) respectively. These towns both have industrial processes, which result in the release of hazardous substances into the atmosphere within their boundaries. In contrast Warrington, which has far fewer sources of pollution, had an ASRDR of 88 (83-92). When these ASRDR's were mapped at electoral ward level it was apparent that these variations are unlikely to be explained by deprivation. Further studies are planned to establish if the excess risk of kidney disease is causally related to the chemical pollution in the area.

10703- THRESHOLD CONCENTRATIONS OF HAIR METALS FOR CHANGES OF CHILDREN'S IMMUNOLOGICAL PARAMETERS

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Children's immune system is very sensitive to environmental pollution by harmful metals. Its activity or suppression depends on quantity of exposure.

Objective. To determine Pb, Mn and Cd threshold concentrations in children's hair to which the response of immune system is related.

Methods. The cross-sectional study included 423 healthy children of 10-11 yr. (group 1) and 16-17 yr. (group 2). Concentration of IgG, IgA and IgM in serum (g/l) was determined by radial immunodiffusion method by Mancini. T and B cell count (%) determined by E and EAC rosette formation method. Phagocytosis index (%) determined by latex phagocytosis of neutrophils. Pb, Mn and Cd concentration in hair was determined by AAS. The original statistical analysis program was developed for finding the most significant threshold value of parameter.

Results. The different immune response in different age groups was found in previous studies. Therefore the separate heavy metals (HM) concentrations were determined for 2 age groups. The following main thresholds were found:

Age, yr.	Heavy metal	HM concentration, $\mu\text{g/g}$	Change of immunological parameter
10-11	Pb	2.62	IgG increased
	Pb	3.30	phagocytosis index decreased
	Mn	2.06	T cell count increased
	Mn	1.02	phagocytosis index decreased
	Cd	0.146	T cell count increased
	Cd	0.245	B cell count increased
	Cd	0.212	IgG increased
	Cd	0.280	phagocytosis index increased
16-17	Pb	1.33	IgG increased
	Pb	2.06	phagocytosis index decreased
	Pb	1.75	IgM decreased
	Mn	1.88	T cell count increased
	Mn	3.38	phagocytosis index decreased

Conclusion. The findings suggest that children's immune response is related to low levels of heavy metals in hair.

10725- Bone Lead and Changes in Cognitive Test Outcomes in the Normative Aging Study
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The prospective relationship between bone lead levels and cognitive test performances between 1993-1997 was examined among 179 male participants in the Normative Aging Study, a cohort of older men from the general community around Boston with relatively low bone and blood lead levels. A battery of five cognitive tests (Digit Span Backwards, Word List Memory, Verbal Fluency, Constructional Praxis, and Pattern Comparison) encompassing specific functional domains (i.e., attention, verbal memory, and verbal and visuospatial skills) was administered at two timepoints approximately three years apart. The age range of these subjects at baseline was 52-85 years (mean= 66.5, standard deviation (SD)=6.5). Tibia bone lead concentrations ranged from -3 to 126 ppm (median=20), patella bone lead levels ranged from -10 to 165 (median=26), and the mean blood lead level was 5.4 mcg/dl (SD=3.3). Tibia bone lead was significantly correlated with patella bone lead ($r=0.81$). Higher tibia and patella bone lead levels were each significantly correlated with older age, fewer years of education, and higher blood lead levels. Separate multivariate linear regression analyses were performed where the tibia bone lead or patella bone lead level at the first timepoint was the independent variable and the change in each cognitive test performance between the second and the first testing session was the dependent variable. After controlling for age and education, higher tibia and patella bone lead were each significantly associated with a decline in the Constructional Praxis test performance as measured by the weighted sum score (regress.coefficient_{tibia}=-0.070; $p=0.0002$; regress.coefficient_{patella}=-0.071; $p=0.02$). For example, the difference in the weighted sum score on the Constructional Praxis test between timepoints was 1.5 points worse in those subjects with patella bone lead levels at the 75th percentile (38 ppm) compared to those subjects with levels at the 25th percentile (16 ppm). This difference is similar to the effect associated with three years less education in this study group. The results support the hypothesis that higher bone lead, a reflection of cumulative lead exposure, is associated with declines in cognitive test performance within the domain of visuospatial abilities (Constructional Praxis). Bone lead levels were not found to be associated with decline in verbal abilities.

10886- Methylmercury Exposure from Contaminated Fish Consumption: An Overview of the Body Burden of Latin American Children and Women

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In Latin America, human populations living downstream from artisanal gold production areas are at increase risk of exposure to methylmercury (MeHg) from contaminated fish consumption. MeHg is a potent neurotoxin and the children's developing nervous system may be particularly vulnerable to the adverse effects of these exposures. The objective of this analysis was to develop a profile of the MeHg body burden of Latin American children and women of childbearing age living close to gold production areas. We have conducted a review of the published literature indexed on MEDLINE and LILACS for this purpose. We limited this review to studies with data on the Hg body burden of children or women for whom fish consumption was presumably the major pathway of exposure. There were four studies from which specific information on the Hg body burden of women or children could be abstracted. There are other studies published, however, due to the way the data was presented it was not possible to abstract the information wanted. These four studies were conducted in Brazil, among different communities living along the Amazon River Basin. The range of mean hair Hg concentrations from these studies was 0.8-83.5 µg/g among children and 0.8-94.7 µg/g among women. The only study from another country was a study from Chile, which looked at the body burden in women in relation to Hg releases from the chlor-alkali industry. The WHO estimated that Hg levels of 10-20 µg/g in maternal hair could be associated with a 5% risk of developing neurologic disorders. Although the general population does not face a significant health risk from MeHg, the data from Brazil suggest that there are children in Latin American at increased risk of developing neurologic disorders from these exposures. The prevalence of hair Hg concentrations above 10 ug/g among women reached 67% in one of the studies; suggesting a high prevalence of MeHg exposure from fish consumption among women living close to gold mining areas. Artisanal gold mining also occurs in Bolivia, Colombia, Guyana, Nicaragua, Peru, and Suriname. We are currently requesting assistance from counterparts on these countries to locate unpublished reports or other information with which to complete the profile.

10968- BONE LEAD MOBILIZATION DURING PREGNANCY AND LACTATION

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Despite the overall decline in environmental lead concentrations and the subsequent reduction in blood lead levels among residents of Mexico City, there is still concern about the extent to which past lead exposure accumulated in bone stores may be mobilized. Pregnancy and lactation have been recognized as powerful stimuli for bone resorption and therefore may be associated with an increase in lead exposure due to the mobilization of maternal bone lead into blood stream. **OBJECTIVES:** To evaluate and compare the relationship between bone resorption and plasma lead during pregnancy and lactation among women with no history of occupational lead exposure. **METHODS:** From May 1997 to April 1999 women who visited four hospitals of the social security system in Mexico City who were planning to get pregnant or with suspicion of pregnancy were invited to participate in the study. Maternal evaluations were in the 1st, 2nd and 3rd trimesters and at 1, 3, 7, and 12 months postpartum. At each evaluation, plasma and whole blood samples were collected using an ultra-clean method and analyzed for lead using ICP-MS; maternal bone lead levels were determined using a KXRF instrument. We evaluated bone resorption by measuring cross-linked N-telopeptides of type I collagen (NTx) in the second morning urine specimens with an enzyme-linked immunosorbent assay. A questionnaire was administered to update information regarding environmental and dietary lead exposure and intake patterns. Separate longitudinal analyses, for pregnancy and for lactation, were carried out using random effects models. **RESULTS:** Maternal plasma lead concentrations were analyzed during pregnancy and lactation in relation to bone lead, urinary NTx and other covariates. Plasma lead levels declined over the course of pregnancy: 0.17, 0.14 and 0.13 ug/L while after delivery, levels increased for lactating women (0.15, 0.18, 0.25, 0.20 ug/L at 1, 3, 7 and 12 months postpartum respectively); non-lactating women showed a decreasing trend in plasma lead levels. NTx values increased significantly during pregnancy reaching a maximum in the 3rd trimester and then declined after delivery for non-lactating women; for lactating women, they remained increased. In a multivariate random effect model, we observed a significant interactive effect of bone lead levels and NTx on log-transformed plasma lead levels. **CONCLUSIONS:** These results provide more evidence supporting the hypothesis that bone resorption increases during the pregnancy and that this bone turnover constitutes a significant stimuli to release lead from maternal bone.

10977- CONTROLLED TRIAL IN PREGNANCY OF CALCIUM SUPPLEMENTS FOR THE SUPPRESSION OF BONE RESORPTION AND MOBILIZATION OF LEAD INTO PLASMA.

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Recent evidence indicates that there is a marked increase in the mobilization of lead from maternal bone stores into circulation during pregnancy and lactation constituting a potential risk of fetal toxicity. These findings pose a major public health problem, even in countries with declining lead exposure, given the persistence of lead stored in maternal bone. Our previous research supports the hypothesis that one possible strategy for suppressing this mobilization during pregnancy, particularly among this population with a low dietary calcium intake, is a nutritional intervention. **OBJECTIVE:** To evaluate the effect of calcium supplements on the suppression of bone resorption and mobilization of maternal bone lead into plasma during pregnancy. **METHODS:** From December 2000 to date, women who visited five maternity hospitals of the social security system in Mexico City with suspicion of pregnancy were invited to participate in the study. We conducted a randomized double-blind placebo controlled trial of a daily calcium supplement (1200 mg) starting at first trimester of pregnancy; evaluations continued at 2nd and 3rd trimesters of gestation. At each evaluation, plasma and whole blood samples were collected using an ultra-clean method and analyzed for lead using ICP-MS. We evaluated bone resorption by measuring cross-linked N-telopeptides of type I collagen (NTx) in the second morning urine specimens with an enzyme-linked immunosorbent assay. A questionnaire was administered to update information regarding environmental and dietary lead exposure and intake patterns. Maternal bone lead levels were determined at one month postpartum using a KXRF instrument. **RESULTS:** Preliminary results will be available for the meeting.

10982- THE RELATIONSHIP OF BLOOD AND BONE LEAD TO MENOPAUSE AND BONE MINERAL DENSITY AMONG MIDDLE AGED WOMEN IN MEXICO CITY.

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OBJECTIVE: to describe blood lead levels and their relationship to menopause and bone lead levels. **MATERIAL AND METHODS:** a cross-sectional study was carried out on 232 pre- and post- menopausal women (PreM and PosM) who participated in an osteoporosis-screening program in Mexico City during the first quarter of 1995. Information regarding reproductive characteristics and known risk factors for blood lead was obtained using a standard questionnaire by direct interview. Blood-lead was determined by graphite furnace atomic absorption spectroscopy. Bone-lead was measured with a ¹⁰⁹Cd K-X-ray fluorescence instrument. We used linear regression to model the relationship between blood lead levels and variables of interest. **RESULTS:** The mean age of the population was 54.7 years (SD 9.8), with a blood lead mean of 9.2 µg/dl (SD 4.7 µg/dl and range from 2.1 to 32.1). After adjusting for age and bone-lead, the mean blood-lead level was (1.98 µg/dl) higher in PosM women than in PreM women (p=0.024). The increase in mean blood lead levels peaked during the second year of amenorrhoea with a level that was 3.51 µg/dl higher than that of PreM women. Other important predictors of blood-lead levels were trabecular bone lead, and use of hormone replacement therapy. **CONCLUSIONS:** these results support the hypothesis that release of bone lead stores is increased during menopause and constitutes an internal source of exposure that may be associated with health effects in women going through the menopause transition.

11005- Elevated Blood Lead Levels in Peruvian Children: The Case of La Oroya, Perú

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Perú is one of world's main lead producers, thus, lead represents a major environmental hazard in the country. La Oroya is a town located in the central region of Perú where a large smelting facility is located. We conducted the study to determine blood lead levels and risk factors for elevated blood lead levels in children from La Oroya. Trained interviewers used a standardized questionnaire to collect data on demographic factors, proximity to the facility, and hand-to-mouth behaviors. A capillary blood sample was taken and the lead content measured by anodic voltammetry. The study group consisted of a sample of 350 children of which 52% were male and the mean age was 6.9 ± 1.6 years. The mean blood lead level of the study group was 32.9 ± 13.0 ug/dl. The range of blood lead concentrations was 6.9 to 79.9 ug/dl. About 99% of the children had blood lead levels above 10 ug/dl. The highest mean blood lead levels were observed in the children who lived closer to the smelting facility (44.7 ± 10.3) when compared to those living farther away (29.0 ± 10.7). However, the high prevalence of children with lead levels above 10 ug/dl suggests that there is widespread lead contamination in La Oroya. The stratified analyses also suggest that washing the hands before meals could reduce lead intake. We found that mean blood lead levels were higher among children who reportedly did not washed their hands before meals (43.4 ± 4.3 ug/dl) in comparison to the children who always washed their hands (30.7 ± 14.0 ug/dl). Lead pollution is a significant environmental health problem in La Oroya and remediation and health education activities should be implemented to reduce children's blood lead levels.