aimed to identify determinants of PM_{10} and $PM_{2.5}$ levels in poultry barns and evaluate the effectiveness of electrostatic precipitators (ESP) to reduce environmental air pollution.
Methods PM_{10} and $PM_{2.5}$ Harvard impactor samples were collected in "side-by-side" barns (one with an ESP, one without) at five poultry farms in British Columbia, Canada from 2008 to 2012. Measured particulate levels were analysed using multimodel inference and linear mixed-effects models after log-transformation. Random effects were added to account for clustering within farms, barns, and rearing cycles.
Results A total of 234 $PM_{2.5}$ and 230 PM_{10} valid samples were modelled. Geometric means of $PM_{2.5}$ and PM_{10} were significantly lower in barns with ESP control in place (151 and 427 g/m^3, respectively) compared to barns with no control (334 and 969 g/m^3), resulting in unadjusted % reductions of 47% and 50% respectively.

In statistical models, the fixed-effects explained 57% and 72% of the total variance in the $PM_{2.5}$ and PM_{10} measurements, respectively. The residual (i.e. within rearing cycle) and between rearing cycle variance were the most affected by adding the fixed effects structure. Strongest determinants in the models for both dust types were ESP use (i.e. approximately halving particulate levels for both $PM_{2.5}$ and PM_{10}), bird age (i.e. 10–30 fold increase in particulate levels depending on bird and particulate type), and type of bird (i.e. approximately a 2.5 fold increase for $PM_{2.5}$, and four fold increase in PM_{10} for turkey compared to chicken). Interactions were suggested in PM_{10} models between type of bird, bird age, and ESP use.
Conclusions The use of ESP resulted in significant reductions in in-barn particulate even after controlling for other determinants such as bird age, type of bird, ventilation, and date.

Session: 3. Electro magnetic fields and health

239 MEASUREMENTS OF OCCUPATIONAL EXPOSURE TO EMF EMITTED BY HIGH-SPEED MAGLEV TRANSPORTATION SYSTEM AND ITS HEALTH EFFECTS

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Objectives High-speed Maglev transportation system is an advanced technology using magnetic forces to propel, levitate, and guide the trian. Our study was to assess the EMF emitted by High-Speed Maglev Transportation System and the possible health effects of occupational exposure to the Maglev EMF.
Methods The static magnetic field of Maglev were measured by Narda ETM-1 magnetic field measurement system. The time-varying EMFs of Maglev were evaluated by PMM8053 EMF measurement system. 48 employees exposed to maglev EMF were selected as occupationally exposed group while 54 employees without any Maglev EMF exposure were selected as control. Questionnaires were sent to two groups. Complete blood count was done by haematology analyzer. Blood lipid level was detected by enzymatic method. Thyroid function related hormones was evaluated by chemical immune assay. Serum melatonin level was measured by an ELISA kit.
Results EMF strength of all Maglev sites was lower than the safety exposure limits of current international and Chinese national standard.

The symptoms of drowsiness, memory impairment, irritability, alopecia were related to occupational exposure to maglev EMF. Abnormal rate of cholesterol and high density lipid protein in exposed group were significantly higher than control. The blood cell counts, thyroid function, and serum melatonin level had no statistical difference between two groups.
Conclusions EMF emitted by the High-speed Maglev transportation system in different frequencies were lower than the exposure limits of current international and Chinese national standard.

Due to the population limits, we can not draw a conclusion that occupational exposure to Maglev EMF may have adverse health effects from the previous data. However, it may gives us a clue that occupational exposure to maglev EMF may result in the alteration of neuronal function and lipid metabolism.

240 NO INFLUENCE OF MAGNETIC RESONANCE IMAGING SCAN ON MALE REPRODUCTIVE HORMONES

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Objectives To investigate if magnetic resonance imaging (MRI) influences male reproductive hormones. The use of MRI is increasing around the world and the possible adverse effects on reproductive health of electromagnetic fields (EMF) in MRI are not previously studied. Previous articles have suggested that radio frequency (RF) electromagnetic fields may influence on male reproductive hormones follicle stimulating hormone (FSH) and luteinizing hormone (LH), and that this may cause reduced sperm quality.
Methods A randomised balanced cross-over study using real and sham MRI scan among 24 healthy male volunteers were conducted. Serum-blood samples of Inhibin B, testosterone, LH, FSH, sex-hormone binding globulin, oestrogen, prolactin and thyreotropine were taken immediately before and after the different scans and at a control session without any scan. Questionnaire data was gathered regarding possible confounding factors among the participants at each session. The RF EMF exposure caused by the MRI scanner was described as RF estimates for each sequence driven during the scan.
Results When investigating the hormone levels immediately before and immediately after the scan we found no differences, neither in the MRI scan setting nor in the sham setting. We also investigated if the hormones changed differently in the MRI setting versus the sham setting, but found no differences. We could neither find an effect after 11 days, which was the average number of days between the different sessions.
Conclusion EMF exposure during a MRI did not cause changes in male reproductive hormones. Adverse effects on other endpoints than male reproduction or possible chronic effect of multiple MRI scans have not been investigated in this study. To evaluate this, further studies should be carried out.

241 OCCUPATIONAL EXPOSURE TO EXTREMELY LOW FREQUENCY MAGNETIC FIELDS AND BRAIN TUMOURS IN THE INTEROCC STUDY

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Objectives Brain tumours are a serious, often fatal disease with few established risk factors. Although ionising radiation has been clearly linked with brain tumours, there are a number of other environmental and occupational agents suspected including extremely low frequency magnetic field (ELF-MF) exposure. However the literature is inconsistent, and questions remain due to small sample sizes and limitations in exposure assessment in previous studies. The objective of this paper was to examine the association between occupational exposure to ELF-MF in different time windows and brain tumours in the large-scale INTEROCC study.

Methods The INTEROCC study is formed by seven participating countries Australia, Canada, France, Germany, Israel, New Zealand, United Kingdom) from the parent INTERPHONE study. Cases of primary brain glioma and meningioma aged at least 20 years were recruited between 2000 and 2004. Detailed occupational history data was collected for jobs held at least six months. Job titles were coded into standard international occupational classifications and estimates of mean workday ELF-MF exposure assigned based on a job exposure matrix. Conditional logistic regression was used to obtain adjusted odds ratios and 95% confidence intervals.

Results Data on a total of 3,978 brain tumour cases, including 2,054 gliomas and 1,924 meningiomas, were analysed with 5,601 control subjects. Estimates of cumulative exposure, time-weighted average exposure, maximum exposure, and exposure duration were calculated for exposure 1–4, 5–9, and 10+ years in the past. Estimates of mean cumulative exposure were higher for males, older participants, and participants with lower levels of educational attainment. Positive associations between different indicators of ELF-MF exposure in the 1–4 year time window and glioma but not meningioma were observed.

Conclusion Occupational ELF-MF exposure may play a role in the promotion of glioma, however findings may also be due to reverse causality or other methodological sources of bias.

242 QUANTITATIVE MEASUREMENTS OF OCCUPATIONAL EXPOSURE TO STATIC MAGNETIC STRAY FIELDS FROM MRI SCANNERS IN CLINICAL AND RESEARCH ENVIRONMENTS

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Objectives Workers' exposure to static magnetic stray fields from MRI scanners was evaluated in a large cross-sectional study in The Netherlands. Factors determining the exposure to static magnetic fields (SMF) and time-varying magnetic fields (TVMF) like scanner characteristics, work patterns and individual practices could be quantified.

Methods Occupational exposure to static magnetic fields (*B*) and rate of change of field due to movement through a static magnetic field (d*B*/d*t*) were measured using a Magnetic Field Dosimeter (University of Queensland). About 480 predominantly full-shift measurements were collected from more than 300 employees working at 14 clinical or research MRI facilities. During measurement days, participants kept a log of the tasks they performed and the scanner (s) at which they worked.

Results Highest peak B and d*B*/d*t* exposures were observed among MRI radiographers and research staff. Peak exposures were highest in academic hospitals (mean [range]: 814 mT [36 - 4928]; 1291 mT/s [27 - 5057]) and lowest for people working in experimental animal imaging facilities (mean [range]: 227 mT [31 - 625]; 395 mT/s [32 - 1329]). Scanner field strength showed a strong association with peak B and dB/dt exposure when subjects worked near a closed bore scanner. However, for small bore scanners this association appeared to be negative. This could be partially explained by variability in shielding (active vs. passive) of the small-bore magnets.

Conclusions For assessment of exposure for epidemiological studies classification solely based on scanner field strength is insufficient. The type of scanner (open/closed/extremity scanner; large/small bore) and type of shielding of the static magnetic field (active/passive) should be taken into account as well.

243 OCCUPATIONAL EXTREMELY LOW FREQUENCY MAGNETIC FIELD EXPOSURE AND CANCER INCIDENCE IN A LARGE PROSPECTIVE COHORT STUDY

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Objectives This study investigated the association between exposure to occupational extremely low frequency magnetic fields (ELF-MF) and various types of cancer within the prospective Netherlands Cohort Study (NLCS).

Methods For this case-cohort analysis, 120,852 men and women aged 55 to 69 years at time of enrollment in 1986 were followed up (17.3 years) for incident cases of lung, breast, brain and haematopoietic cancers and their subtypes. Information on occupational history and potential confounders such as sex, age, smoking, alcohol use and attained educational level were collected at baseline through a self-administered questionnaire.

Occupations were coded using the International Standard Classification of Occupations (ISCO-88). Occupational ELF-MF exposure was assigned by using a semi-quantitative ELF job-exposure matrix which assigns ordinal exposure levels (background, low and high exposure) based on intensity and probability of exposure. Metrics of ELF-MF exposure were ever low and ever high exposure versus background exposure, duration of exposure, and cumulative exposure to ELF-MF up to baseline. Associations with cancer incidence were analysed with Cox-regression using attained age as underlying time scale.

Results Ever low or ever high exposure to ELF-MF showed no effect on cancer incidence of lung, breast, brain cancer, nor any of the assessed subtypes. Duration and cumulative exposure also showed no effect of ELF-MF exposure on these cancer sites. Ever high exposed to ELF-MF showed a significant association with acute myeloid leukaemia (AML) (hazard ratio [HR] 2.09; 95% confidence interval [CI] 1.05–4.15) and follicular lymphoma (HR 2.40; 95%CI 1.00 - 5.77). In addition, cumulative