Japan EMF Information Center

Rapid Response Group

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Paper

Li DK, Chen H, Odouli R. Maternal Exposure to Magnetic Fields During Pregnancy in Relation to the Risk of Asthma in Offspring. Arch Pediatr Adolesc Med 2011; published online August 1, 2011. Doi:10.1001/archpediatrics.2011.135

Executive summary

The association between asthma in offspring and a one day 24-hr measured maternal exposure to 60 Hz magnetic fields (MF) during pregnancy was investigated in a Californian prospective cohort study. Following birth, 626 children were followed for up to 13 years. The risk of asthma increased significantly with each 1-mG-increase of maternal MF exposure by 15% (95% CI: 4 to 27%) after adjustment for potential confounders. A categorical analysis found a 3.5 fold increased asthma rate (95% CI: 1.7 to 7.4) for children whose mother had a high MF level (>2.0 mG). The effect of MF was more pronounced in firstborn children and in children with a maternal history of asthma.

This study has a number of strengths: exposure was made for 24-hrs MF measurements were made before diagnosis and so not prone to recall bias; as a prospective study selection or participation bias is minimized; in all children asthma was clinically diagnosed and confirmed within 12 months; diagnosis was made without prior knowledge of MF exposure and so diagnosis misclassification is unlikely to be related to exposure; and high completeness of follow-up minimized the risk of selective drop-outs. However the study has limitations: it is not known whether a 24-hr MF measurement provides typical exposures during the 1st or 2nd trimester of pregnancy or whether this represents average exposure during the whole pregnancy or how this might be influenced by MF exposure at home or work; and no data are provided on how often families changed residence during pregnancy and how this affected exposure, thus some exposure misclassification seems unavoidable. However, because of the prospective design, the extent of exposure misclassification should differ little between mothers of asthmatic and non-asthmatic children and so minimize non-differential exposure misclassification. Also such errors tend to shift the risk estimates towards unity rather than producing a false

positive finding. Since the study was originally designed to investigate MF exposure effects on miscarriage, several potential confounders for asthma were not collected e.g. social contacts, air pollution exposure, diet or exposure to allergens. However whether these factors are also related to MF exposure is not known. Case inclusion, the choice of summary measure and cut points and several other aspects of analysis are very problematic.

As the first cohort study on the association between maternal MF exposure and asthma in offspring it deserves to be followed-up with larger, well-conducted studies.

Description of study

Li et al. reported an increased risk of asthma in offspring associated with maternal MF exposure recorded during pregnancy (1).

Cohort and Case Definition

The subjects were the children of women who had taken part in an earlier study of maternal exposure to 40-800 Hz MFs and miscarriage published in 2002 (2). The cohort was recruited from October 1996 through October 1998, among members of the Kaiser Permanente Medical Care Program (KPMCP) in Northern California who became pregnant. Of the 2,729 pregnant women eligible for the miscarriage study, 1,380 agreed to participate, 1,063 were interviewed and 829 delivered a live birth. The cohort of children born from these pregnancies was followed prospectively until age 13. After excluding participant lost to follow-up, did not have MF measurements, or whose asthma diagnosis was uncertain there remained 626 participants for analysis in this study.

Magnetic field measurement

Mothers wore an EMDEX-II meter (logging every 10 seconds) for 24 hours during the first or second trimester (n=969). Sixty-seven did not result in a valid 24-hour MF personal exposure measurement. The analysis used the median MF as the exposure metric to minimize potential difficulties with outliers. The exposure was treated both as a continuous and a categorical variable, the latter with cut-points at the 10th percentile (<0.3 mG), medium group (> 0.3 mG- <2.0 mG) and the 90th percentile (>2.0 mG) to form Low, Medium and High exposure groups.

Analysis

The children were followed up either to age 13, asthma diagnosis, or exclusion from the group for any reason, or when the study ended, whichever came first. The hazard ratio (HR) based on the person-time concept was used as the measure of relative risk. The investigators considered a number of potential confounders: maternal age, race, education, maternal history of asthma and smoking during pregnancy and adjusted for them in most

analysis. However, since this study was originally designed to investigate the effects of MF exposure during early pregnancy on miscarriage information on several potential risk factors for asthma was not collected and was unavailable for the analysis (e.g. social contacts, previous virus infection, exposure to tobacco smoke, air pollution exposure, diet or exposure to allergens).

Results

A significant linear dose-response relationship was observed between increasing maternal median daily MF exposure level during pregnancy and an increased risk of asthma in offspring (adjusted hazard ratio [aHR], 1.15 per 1 mG; 95% confidence interval [CI], 1.04-1.27).

When exposure was grouped into 3 categories, with the low category used as the reference group, the authors observed an aHR of 1.74 (95% CI = 0.93-3.25) for medium exposure and 3.52 (95% CI = 1.68-7.35) for high exposure. A similar but weaker association was seen among suspected asthma cases, with aHRs of 1.24 and 1.41 for medium and high exposures respectively. A much stronger association was observed in a subset of children whose mothers had a history of asthma (aHR=6.06 (95% CI; 2.20-16.72)). The association appears to be limited to first born. The association was stronger when women reported the day of measurement to be a "typical" day: the aHR for Medium/High exposure groups referenced to the Low group on a typical day was 2.52 (95% CI; 1.01-6.30), compared to aHR of 1.31 (95% CI; 0.55-3.13) for measurements for a reported non-typical day.

Analysis of results

While the study by Li et al. has the advantage of a cohort design, it also has numerous limitations. The cohort of pregnant women used for the current investigation was from the same group who were the subject of a previous study by Li and colleagues addressing the association of MF exposure with miscarriage.

Cohort and Case Definition

The definition of asthma diagnosis used in their study was potentially problematic. A large percentage of cases were excluded. Cases had to be diagnosed on at least 2 occasions within a 1-year period during follow-up, thus children with good medication control were excluded. When all children with asthma diagnosis in this cohort are included, the prevalence appears to be much higher than the prevalence of 13% observed in the general population of children in the United States.

Measurement of MF ***exposure***

The choice of summary measure and cut points seems particularly problematic. The initial study reported an increased risk of miscarriage associated with at least one encounter with a field ≥16 mG, but no statistically significant associations with time-weighted average measures. However in this study the median of 24-hour measurements were used. The rationale behind the choice of MF metrics (average versus highest encountered) and cut-points (above 2 mG versus 16 mG) used in this study is not given and is not clear.

While a personal measurement captures all exposures on a given day, it is unclear how representative this measurement is for the entire 9 month of pregnancy. Some have suggested that one-day MFs measurements during pregnancy could have been biased by conditions of pregnancy such as morning sickness.

Analysis

The choice of 3 categories is strange, in particular use of the 10th percentile as the reference group (resulting in only 11 cases). In general, it is important that the reference group is stable and thus includes a large number. Often 50% (but at least 25%-33%) of the subjects are put in reference group.

The analysis lacked control for some potentially important confounding factors, such as viral infections that are known to be a strong risk factor for asthma.

Authors report an unusual association between income and their magnetic exposure grouping: the % in various exposure groups increases in the lowest and highest income group, but decreases in the middle income group. Thus while authors attempted to control for income in their analysis, it is likely that they did not succeed.

Finally, it is unclear why the high and medium exposure groups are combined in some analysis (Table 4), again relying only on the lowest 10% as a reference group.

Discussion and conclusions

Ten years ago, Beale et al. conducted a cross-sectional study to examine the dose-response relationship between the MF exposure of adults in their homes and prevalence of immune-related and other chronic illnesses (3). Five hundred and sixty adults living near extra high voltage transmission lines completed questionnaires about their health and demographic characteristics. After adjustment for possible confounding, significantly elevated odds ratios were observed at higher exposure levels for both asthma and combined chronic illnesses. Due to numerous weaknesses, Beale's study received little attention and no follow-up.

While this study includes ELF and RF measurements, in their justification authors include (and confuse) both ELF and RF exposures. However, as this is the first look at exposures in pregnancy and asthma, this finding deserves replication.

References:

1. 1. Li DK, Chen H, Odouli R. Maternal Exposure to Magnetic Fields During Pregnancy in Relation to the Risk of Asthma in Offspring. Arch Pediatr Adolesc Med 2011; published online August 1, 2011. Doi:10.1001/archpediatrics.2011.135

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