EMFs and Miscarriages: The Evidence Mounts

At Least 7 Studies Now Show an Association
Kaiser's De-Kun Li Answers His Critics

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Magnetic fields at levels commonly found in homes, offices and the urban environment have once again been found to increase the risk of pregnancy loss. The latest study —from Kaiser Permanente in Oakland, CA— shows that power-frequency fields can triple the risk of miscarriages.

"This study provides fresh evidence, directly from a human population, that magnetic field exposure in daily life could have adverse health impacts," De-Kun Li, the lead author of the Kaiser study, told *Microwave News.* These findings "should bring attention to this potentially important environmental hazard to pregnant women," Li urges.

There are now at least seven studies linking miscarriages to prenatal exposure to electromagnetic fields, according to Li.

While this latest epidemiological study will not bring the never-ending controversy over weak field effects to an end, it is unlikely to be ignored. The Kaiser paper was released a few days ago in *Scientific Reports*, an open access journal from the publisher of *Nature.*

"This is an important, well-conducted study," said Tony Miller, an emeritus professor of epidemiology at the University of Toronto.

David Savitz agrees. "This is a very nicely designed study," he wrote in an e-mail message from Brown University in Rhode Island, where he teaches epidemiology at the medical and public health schools. Like Miller, Savitz has had extensive experience studying EMF health impacts.

A Miscarriage Risk Above 2.5 mG

The Kaiser researchers strived to accurately estimate the women's exposures to magnetic fields. They ran a *prospective* epidemiological study and measured the fields on a typical day during the pregnancies. More than 10% of the eligible women were later excluded because of incomplete exposure data, leaving a total of 913 participants.

The magnetic fields were measured with an EMDEX Lite meter, made by Enertech Consultants in California. (It registers fields from 40 Hz to 1,000 Hz.) Li then evaluated the women's magnetic field health risks by focusing on their peak exposures rather than the 24-hour averages, which used to be the standard practice.

Those exposed to fields of more than 2.5 mG (0.25 μT) for at least 14 minutes (1% of 24 hours) of the day they wore the meter were 2.72 times more likely to miscarry than those exposed to less than 2.5 mG (the control group). This is a statistically significant finding. The increased risk of miscarriage associated with the higher magnetic fields was independent of the source of the fields, Li said. He explained that while he did not have information on the exact sources (e.g. power lines, appliances, etc.), most of the exposures were from the following locations: home, home in bed, work and in transit.

Women exposed to peak magnetic fields above 2.5 mG had a miscarriage rate of 24.2%. The rate among those in the control group was 10.4%, which is consistent with the 10-15% that has been found in the general population.

Approximately a quarter of the U.S. population is exposed to over 4 mG for more than an hour a day, according to the last national survey of exposures to magnetic fields. That survey was completed about 20 years ago (see *MWN,* M/J98, p.4).

The Kaiser team did not see a dose-response. The increased risk stayed about the same for peak exposures above 2.5 mG. In fact, the miscarriage rate dipped down somewhat among the most exposed women, those with peak exposures greater than 6.2 mG for 1% of their typical day. The risk for this group was approximately double that of the controls. For those exposed to between 2.5 mG and 6.2 mG, the risk was more than three times higher than that of the controls.

The absence of a dose-response may be due to a threshold effect, says Li. Fields above 2.5 mG could lead to the loss of pregnancy with higher exposures conferring no additional risk, the team states in the paper.

This is Li's second EMF–miscarriage study. Fifteen years ago, he showed that the miscarriage risk could be up to six times higher for women exposed to 16 mG or more. Back then, he classified exposures based on the absolute maximum magnetic fields the women encountered over the course of a day (for details, see our story).

In order to get a more "stable" measure of exposure in the new study, he used what he calls the "99th percentiles" of the women's

24-hour exposures . This strategy eliminates the absolute maximum exposure, which as Savitz points out, may represent nothing more than a “very quirky moment.”

When asked how to define the 99th percentile, Li explained that if a woman’s 99th percentile level was 3.5 mG, she was exposed to magnetic field levels of 3.5 mG or higher for 14 minutes on that “typical” day.

Magnetic Fields vs Nausea

Li’s 2002 study met with immediate skepticism, some of it brutal. The late Sir Richard Doll, for instance, stated that his findings do not provide “worthwhile evidence of an increased risk” and they probably do not “even justify further investigation.”

Savitz was another, though less caustic, critic. In a commentary that accompanied Li’s first paper published in the journal *Epidemiology,* Savitz argued that what Li reported was more likely explained by behavioral differences between women with healthy pregnancies and those who have had or will have a miscarriage. Savitz wrote that the focus should be on the presence or absence of nausea among the women rather than their exposure to magnetic fields.



De-Kun Li (left) and David Savitz

Undeterred, Li set out to see who was right. With funding from the NIEHS (home of the NTP), Li carried out another study, the one that has just come out. It is inconsistent with Savitz’s hypothesis. “Adjustments for both nausea and vomiting did not change the results in this study or in the previous study,” the Kaiser team writes in *Scientific Reports.* (Back in 2002, Li provided *Epidemiology* additional analyses that he stated refuted Savitz’s argument; see his letter to the journal.)

“Savitz got funds from the electric utility industry to try to prove his theory that nausea confounded our study,” Li said in an interview for this article, “but those results failed to support his theory.” In fact, Li added, “our new study essentially confirmed our earlier findings and supported what we reported to the journal in our response to his commentary.” (EPRI, which coordinates research for the electric power industry, sponsored Savitz’s analysis.)

Microwave News asked Savitz if he was now satisfied that nausea had not confounded Li’s studies. “The fact that Li saw the link for women, who did and did not report experiencing nausea, clearly

indicates that nausea does not account for the association," he replied.

Still, Savitz has some concerns, notably about Li's use of the 99th percentile as the metric for exposures to magnetic fields. "Why the 99th and not 95th, 90th, 100th or the 50th percentile?" he asked, adding, "The authors claim that this is the metric that is the one that causes miscarriage, but it may be just the only one that is associated with miscarriage."

Savitz is not ready to concede that the link is real. "While the authors see a very coherent picture in this study and the literature in the aggregate, I don't think most epidemiologists would concur," Savitz said. "They would more likely see the results as intriguing or mysterious rather than telling a clear story."

The Importance of Exposure Assessment

Both Miller and Savitz praised the care with which Li assessed the women's exposure to magnetic fields.

"The Kaiser study is notable for its prospective design," Miller said. He pointed to "the care used to collect measurements of magnetic fields during pregnancy on days that could be regarded as being typical of the exposures likely to be encountered during pregnancy and the fact that Li was able to collect data on other risk factors for miscarriage and verify that they did not confound the observed associations."

Savitz also highlighted the effort that Li made to assess exposures. "The ability to identify women early in pregnancy is a notable strength, as is the ability to conduct personal measurements," Savitz said.

"Studies that examine EMF health effects *must* be able to measure EMF exposure *correctly and accurately,*" Li emphasizes. "The inability to measure EMF accurately or at all (for example, based on interviews) is likely the "ultimate pitfall" for all those studies claiming that they did not find a health effect by EMF (so called "negative studies").

Miller learned the importance of exposure assessment in a major study of Canadian utility workers he completed more than 20 years ago. (For details, see "Both Electric and Magnetic Fields Seen as Critical to Cancer Risk.")

At the time, Gilles Thériault, another Canadian epidemiologist who worked on EMFs, explained what was at stake: "If there is an actual real association, then the more precise the estimate of exposure, the greater chance we have of seeing the real risk," he said. (See "The Three Keys to EMF Epidemiological Studies: Exposure Assessment, Exposure Assessment, Exposure Assessment" p.7.)

Li hopes the new results will "stimulate much needed additional research."

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A paper linking magnetic fields to ADHD has been corrected and updated. This prompted a suggestion that the problem with that paper would also affect the 2017 miscarriage paper in *Scientific Reports.*

When asked about this, Li told *Microwave News*:

> "There has been no change to the MF-miscarriage paper, published in *Scientific Reports* in 2017. We stand by the results & conclusion. Also, as stated previously, the link between magnetic fields and miscarriage has been reported by at least seven studies."

miscarriages, ELF EMFs, De-Kun Li, Sir Richard Doll, David Savitz, Tony Miller, Gilles Thériault, EPRI,

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