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Magnetic fields

Occupational exposures to magnetic fields and neurodegenerative disease risks

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Commentary on the paper by Sorahan and Kheifets (see page 820)

Collectively, the major neurodegenerative diseases—Alzheimer's disease, Parkinson's disease and motor neurone disease—represent a substantial public health burden throughout the world. The vast majority of cases of these disorders are non-familial. Thus, if only by default, it can reasonably be assumed that lifestyle and environmental factors are aetiologically relevant. Unfortunately, epidemiological research has yielded very few clues regarding modifiable risk factors.

During the past 20 years, there have been numerous epidemiological studies that have examined risks for these disorders in relation to aspects of electrical work: electric shocks and magnetic fields. These studies have been of various designs, including population-based case-control studies, follow-up studies of defined occupational cohorts, population-wide census linkage studies, and death certificate surveys. The pattern of evidence that has emerged can best be characterised as mixed, and at most suggestive of aetiological associations. To date, the most consistent results have been observed for electric shocks and magnetic fields with increased risks for amyotrophic lateral sclerosis, the main form of motor neurone disease.¹ However, the evidence is by no means compelling.

In this issue, Sorahan and Kheifets² report findings from a very large, rigorously conducted mortality study of Alzheimer's, Parkinson's and motor neurone disease in a cohort of UK electricity generation and transmission workers for whom quantitative magnetic field exposures were reconstructed (see page 820). The study generated mostly null findings, with the exception of a modest risk gradient for motor neurone disease mortality. Notwithstanding the rather unremarkable results, this study will be a

valuable contribution to the literature insofar as very prominent effects of magnetic field exposures on neurodegenerative disease risks can probably be discounted, at least in the population studied.

Considering the findings from the Sorahan and Kheifets study,² along with previously reported ambiguous results from other cohort studies that also had high quality, quantitative magnetic field exposure assessments,^{3–5} one might question whether this line of research deserves further pursuit. In spite of a fairly low "signal" for an effect of magnetic fields on risks for the neurodegenerative diseases, there is a good rationale for continued investigation. Even small excess risks posed by magnetic field exposures, which are ubiquitous in workplace and residential environments, could have substantial public health significance. Recognition that there is some epidemiological evidence, albeit inconsistent, supporting associations with Alzheimer's disease and amyotrophic lateral sclerosis, also argues in favour of continued investigation, rather than a conclusion that no meaningful aetiological relations exist or can be detected epidemiologically. Furthermore, it should be relatively cost efficient to extend the follow-up of existing cohorts to increase statistical power, which has generally been low because of the small numbers of cases. For example, only 218 of 21 888 total deaths in the Sorahan and Kheifets study were the result of Alzheimer's, Parkinson's and motor neurone disease combined.²

Arguably, the most fruitful further studies would be occupational cohort-based designs which generally offer considerably more detailed and precise exposure assessments than can be obtained in population-based case-control or other

studies. Future research will clearly benefit from improvements in the areas of exposure assessment for co-occurring occupational factors (such as electric shocks and chemicals), disease diagnostic accuracy, and controlling for potentially confounding non-occupational exposures. As Sorahan and Kheifets² acknowledge, their study, like nearly all occupational cohort studies, suffered from reliance on death certificates for disease outcome data. Missed cases and, more importantly, inaccurate diagnoses (especially for Alzheimer's and Parkinson's disease) may have undermined validity and precision somewhat. Confirming disease diagnoses and determining disease onset dates would greatly improve the quality of health outcome data, although obtaining necessary clinical and postmortem information may pose logistical challenges in some instances.

Based on the body of available literature, it seems likely that the magnitude of excess risk for Alzheimer's, Parkinson's, or motor neurone disease attributable to magnetic fields is probably small or, in the case of Parkinson's disease, perhaps nil. Consequently, potential confounding from occupational and non-occupational exposures would be of greater concern than is typically the case in occupational cohort studies. Control for carefully measured confounders would be necessary to avoid underestimating or missing associations with risk. Among non-occupational factors, cigarette smoking, which has a well-established inverse ("protective") association with Parkinson's disease,⁶ but has been related with increased risks for Alzheimer's disease⁷ and motor neurone disease,⁸ although somewhat inconsistently, is of particular concern as a potential confounder, if effect estimates for magnetic fields are assumed to be small.

There are some practical options that can be adopted in future research. Case-control or case-cohort designs nested within individual cohorts may be especially well suited for purposes of diagnostic confirmation and obtaining data on potential confounders. On a larger scale, meta-analyses and pooled analyses of multiple cohort studies (and nested studies within cohorts), applying common protocols for exposure assessment, disease outcome classification, and data analysis may be prove to be highly advantageous for increasing statistical power, assessing consistency of associations, and evaluating effect modification by gender and other factors. In fact, the cohorts need not be restricted to the conventional electrical industries. Data from other

industries that include large sectors of exposed workers, such as textile industry sewing machine operators,⁹ could also be incorporated into pooled studies. The relative strength and consistency of associations of occupational magnetic fields observed among different industries in various geographical locations would shed considerable light on whether these exposures contribute to risks for the major neurodegenerative diseases.

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