

Adult cancers near overhead powerlines

Interim Report

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Project title Adult cancers near overhead power lines

Project director Prof Paul Elliott

Project monitoring A Steering Committee comprising independent experts and representatives of the funders advised on study design and commented on the protocol.

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Project end date 31st December 2011

Interim report date 25th July 2011

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1 Executive Summary

Study question: Is there an increased risk of adult cancers in relation to distance from/exposure to extremely low frequency electromagnetic fields from high voltage overhead power lines in England and Wales?

Context. Extremely low frequency electromagnetic fields are designated as possibly carcinogenic in humans based on an epidemiologic association with childhood leukaemia. Evidence for associations with various adult cancers is inconsistent and currently considered inadequate to make causal judgements.

Design, Setting and Participants. We conducted a case-control study using adult case cancers identified through the national cancer registry data and age-sex-year of registration matched cancer controls (three controls/case except breast cancer, one control/case), ages 15-74 years living within 1000 m of an overhead power line, England and Wales, 1974-2008.

Main outcome measures and exposures. We investigated risks of leukemia (10th revision of the International Classification of Disease, C91-C95), brain/central nervous system cancers (C70-C72), malignant melanoma (C43) and female breast cancer (C50) in relation to distance and calculated magnetic fields within 1000 m of high voltage overhead power lines, adjusted for age, sex (except female breast cancer), deprivation, and rurality. Controls were selected from a range of cancers not considered to be associated with electromagnetic fields: exclusions were malignant neoplasms of lymphatic and hematopoietic tissues other than leukemias; non-melanoma skin cancer; cancers of the lip, oral cavity, pharynx; respiratory cancers including larynx and lung; and cancers of ill-defined, secondary and unspecified sites. Two exposure metrics were estimated: i) distance measures based on a Geographical Information System and ii) calculated magnetic fields based on distance, power load, and line characteristics using the EM2D model. Magnetic field modelling was undertaken by National Grid (NG), blind to case/control status and with an extra 10% locations added to dataset to preserve confidentiality. Estimated exposures were categorised into groups and were also analysed as continuous measures.

Progress to date. The study period has recently been extended from 1974-2003 to 2008 in order to include the latest available cancer registration data from ONS. Exposure estimates have been calculated by NG for the new cases/controls, 2004-2008, and are currently being quality checked. Epidemiological analysis will be updated subsequently to include all data 1974-2008.

Limitations: We had no direct information on migration of cases or controls, and so were unable to allow for cumulative exposures or latency, except for providing estimates at diagnosis address five years previously, which were highly correlated with estimates for year of diagnosis. Calculation of magnetic fields was based on historical load data with inherent inaccuracies. We were only able to take account of magnetic fields from overhead power lines, and had no measurements of actual exposures within the home.

Aims and Objectives

The aim of the study was to investigate the risk of adult cancers (leukemia, brain/central nervous system cancers, malignant melanoma and female breast cancer) in relation to distance and extremely low frequency calculated magnetic fields within 1000m from high voltage overhead power lines, England and Wales, 1974-2008. Using a case-control design, the study was based on adult cancer cases aged 15-74 years identified through the national cancer registry and age-sex-year of cancer registration matched cancer controls (three controls/case except breast cancer, one control/case).

2. Research team

The research team comprised:

Prof Paul Elliott, Dr Kees De Hoogh, Catherine Keshishian, Nina Iszatt, Prof David J. Briggs, Dr Mireille B. Toledano of the Small Area Health Statistics Unit, MRC-HPA Centre for Environment and Health, School of Public Health, Imperial College London, St Mary's campus, London, W2 1PG, UK

Dr Gavin Shaddick of the Department of Mathematical Sciences, University of Bath, Bath BA2 7AY, UK

Dr Norman Cobley of the European Bioinformatics Institute, European Molecular Biology Laboratory, Cambridge, CB10 1SD, UK

3. Analysis of objectives met

The study team was successful in carrying out the research although substantial effort and more time than originally anticipated was necessary to ensure high data quality and linkage processes throughout. This included obtaining addresses for individual cancer records from the ONS (the SAHSU previously held post-coded records only), geo-coding addresses through automatic and manual checking procedures, cleaning cancer data and liaising with ONS regarding appropriate removal of duplicate records, extracting cases and their matched controls within 1000m of power lines using a GIS interface, sending National Grid anonymised locations and additional locations (to increase confidentiality) for them to model and assign exposure estimates, blinded to case-control status.

4. Achievements and ongoing work

As outlined in the study proposal and dated amendments to DH, this study addresses two hypotheses: hypothesis 1 - relates to distance and magnetic fields from overhead power lines; and hypothesis 2 - relates to electric fields from overhead powerlines and aims to A) quantify risk of mouth and respiratory cancers in adults in relation to modelled corona ion discharge up to 600m downwind from powerlines and B) risk of non-melanoma skin cancers in relation to high electric field strengths at ground level within 25m of powerlines.

- a. Hypothesis 1 - Interim analysis for the period 1974-2003 has been completed, and analysis is being extended to 2008 to include the latest available cancer registration data from ONS (as agreed with DH). Exposure estimates have been calculated by NG for the additional cases/controls, 2004-2008, and these are currently being quality checked by NG and SAHSU. Once these checks have been completed, epidemiological analysis will be updated to include all data for the period 1974-2008. As information on migratory patterns and social class of individuals is unavailable in the national cancer registry, we obtained and analysed data from the Office for National Statistics' Longitudinal Study – a 1% sample of the UK population with data on individuals linked across decennial censuses – to estimate possible effects of migration patterns and individual social class on cancer risk near power lines (<100 m, 100-1000 m) between the 1991-2001 censuses. Analysis and write-up of study findings 1974-2008 for submission to the journals is estimated for completion by end of September 2011.
- b. Hypothesis 2 – Aim A: Exposure modelling work is currently ongoing within the SAHSU using a (Gaussian) dispersion modelling approach to estimate exposures to corona ions within 600 metres of all power lines in England & Wales, 1974-2008. Cases and controls have been extracted from the cancer registration database and assigned modelled corona ion exposure estimates based on residential address at year of cancer registration and for 5 years previously. Exposure assessment is now complete for all cases/controls up to 2003. Over the next few weeks, modelling will be undertaken for remaining cases/controls occurring between 2004-2008. In parallel, a fieldwork monitoring campaign was undertaken (now completed) by the SAHSU to validate the corona ion modelling. Repeated monitoring of small air ion concentrations and electric field measurements was undertaken at one site in Northamptonshire (including sites downwind and upwind of power lines under different meteorological conditions). These fieldwork measurements, together with some additional air ion measurements obtained from Bristol University, are currently being analysed and used for model evaluation. In addition, a meta-analysis of studies using similar modelling is currently being undertaken and incorporated into a paper being drafted on the rationale and methodology of the exposure modelling employed for Hypothesis 2 of the study. This exposure modelling paper is due for completion by end of September 2011.
- c. Hypothesis 2 - Aim B: National Grid are currently undertaking electric field calculations (blind of case/control status) for locations of cases/controls lying within 25m of an operating high voltage power line, supplemented by an additional 10% of locations within 25m to increase confidentiality. Epidemiological analysis and write-up of findings will commence as soon as exposure assessment work has been completed.

5. Acknowledgments

We thank Sara Morris, Margaret Douglass, and Peter Hambly (Imperial College London) for their help with data acquisition and analysis. We are grateful to John Swanson (National Grid) who provided data on the locations of power lines and carried out the magnetic fields analyses in EM2D, and electric fields analysis, blinded to case-control status. We thank the cancer registries in England and Wales and the Office for National Statistics for providing data on cancer incidence. The permission of the Office for National Statistics to use the Longitudinal Study is gratefully acknowledged (clearance no.30104A), as is the help provided by staff of the Centre for Longitudinal Study Information & User Support (CeLSIUS). CeLSIUS is supported by the ESRC Census of Population Programme (Award Ref: RES-348-25-0004). The Small Area Health Statistics Unit is funded by the Health Protection Agency as part of the MRC-HPA Centre for Environment and Health at Imperial College London.

The study was approved by the London MREC, reference 05/MRE02/37.

6. Publications and conference presentations

Toledano MB, Briggs DJ, De Hoogh C, Shaddick G, Elliott P. Adult cancers near overhead powerlines: study design. *Epidemiology Vol 18(5) Suppl, September 2007, p S130.*
ABSTRACT.

Toledano MB, Briggs DJ, Swanson J, Shaddick G, Keshishian C, De Hoogh C, Elliott P. Adult cancers near overhead power lines. Presentation given at the BEMS annual conference, 2007.

Toledano MB, Briggs DJ, Swanson J, Shaddick G, Keshishian C, De Hoogh C, Elliott P. Adult cancers near overhead power lines. Presentation given at the EBEA annual conference, 2007.

Paul Elliott, Gavin Shaddick, Kees De Hoogh, Nina Iszatt, David Briggs, Mireille B. Toledano Adult Cancers near Overhead Power Lines. DH Radiation Protection Research Programme, January 2011 (see Appendix).

7. Financial summary

There was an overall spend of £108,555.14.

Appendix

Study abstract, DH Radiation Protection Research Programme, January 2011

Project Number:	RRX 106
Project Title:	Title Adult Cancers near Overhead Power Lines
Authors:	<u>Paul Elliott</u>, Gavin Shaddick, Kees De Hoogh, Nina Iszatt, David Briggs, Mireille B. Toledano (Small Area Health Statistics Unit, MRC-HPA Centre for Environment and Health, Imperial College London)

Extremely low frequency electric and magnetic fields (ELF-EMF) have been implicated in the aetiology of childhood leukaemia. Studies have also investigated ELF-EMF in the occurrence of adult cancers, but the evidence is inconsistent and far weaker than for childhood leukaemia; adult cancer sites possibly associated with ELF-EMF exposures include leukaemia, brain and central nervous system tumours, malignant melanoma and female breast cancer. We carried out a case-control study of incidence of these cancers among residents of England and Wales living near high voltage overhead power lines; grid references of pylons for all 275 and 400kV plus a small fraction of 132kV power lines were obtained from National Grid, together with construction dates. Eligible cases were identified from the national cancer register held by the Small Area Health Statistics Unit; cases were aged 15-74 years at diagnosis, 1974 - 2003, and living within 1000m of a high voltage overhead power line based on geocoding of residential address. Controls (stratified by year of diagnosis and region) were similarly obtained from the national cancer register for a range of cancers not considered to be associated with ELF-EMF. For each case and control cancer, the distance to operating power lines was calculated in a Geographical Information system (GIS). National Grid's EM2D program was used to calculate magnetic fields at each address within 200 m of a power line (100 m if the lines had transposed phasing). Potential confounders considered were

age, sex, and measures of rurality and deprivation (Carstairs score). Case cancers tended to be younger, slightly more affluent and for malignant melanoma and breast cancer, less urban than control cancers. Pearson correlation between calculated magnetic fields in year of diagnosis and five years previously was 0.81. Results for cancer risk with respect to distance and calculated magnetic fields are pending.