Excess risk of kidney disease in a population living near industrial plants

S Hodgson (MSc)\textsuperscript{1}, M J Nieuwenhuijsen (PhD)\textsuperscript{2}, A Hansell (MBBS)\textsuperscript{1}, S Shepperd (D.Phil)\textsuperscript{1}, T Flute (BSc)\textsuperscript{3}, B Staples (MBBS)\textsuperscript{4}, P Elliott (FRCP)\textsuperscript{1}, L Jarup (PhD)\textsuperscript{1}

\textsuperscript{1}Small Area Health Statistics Unit (SAHSU), Imperial College London, UK.
\textsuperscript{2}Dept Environmental Science and Technology, Imperial College London, UK.
\textsuperscript{3}Halton Primary Care Trust & Warrington Primary Care Trust.
\textsuperscript{4}Formerly Consultant Environmental Health, North Cheshire Health Authority.

Correspondence to: Lars Jarup, SAHSU, Department of Epidemiology & Public Health, Faculty of Medicine, St Mary's Campus, Imperial College London, Norfolk Place, London W2 1PG

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Abstract

Runcorn has been a site of chemical industry activity for over a century, where tons of toxic chemicals are released annually to air and water. We found excess kidney disease mortality (nephritis, nephrotic syndrome and nephrosis) in the population living within 2km of the industrial plants (Standardised Mortality Ratio (SMR) in males 131 (95% Confidence Interval (CI) 90-185) and females 161 (95% CI 118-214)) compared to a reference population (North West England). Risk of hospital admissions for kidney disease in Halton (comprising the towns of Runcorn and Widnes) was higher than in the less industrial, nearby town of Warrington. The standardised Admission Ratio (SAR) in Halton was 115 (95% CI 107-124) for males and 126 (95% CI 117-137) for females; and in Warrington 91 (95% CI 85-97) for males and 84 (95% CI 78-91) for females compared to the Warrington and Halton area as a whole. The excess risk of kidney disease in the Runcorn area requires further investigation.
Main Messages

- There is a significant excess of kidney disease and kidney disease mortality in people living near to several polluting sources in Runcorn.
- These excesses may be associated with exposure to kidney toxicants emitted by these plants over the last century.
- Morbidity and mortality ratios were more pronounced in females than males, suggesting that occupation is not a substantial confounder.
Introduction

A commentary published in the Lancet in January 1880 describes how the town of Runcorn is ‘exposed to the irritating vapour cast off so freely by the large chemical works in its vicinity’(1). Today, over a century since this report, Runcorn is still exposed to many toxic chemicals released from over a dozen industrial plants in the area. Emissions data from the UK Environment Agency Pollution Inventory (2) show that substantial amounts of nephrotoxic chemicals, including 125 tons lead, 4 tons mercury, and over a ton of arsenic and chromium were released to air from 16 plants\(^1\) in the Runcorn area between 1998-2000. All these substances have toxic effects on a range of human organs, including the kidneys (3). Three sites are responsible for the majority of nephrotoxic emissions, with mercury being the major nephrotoxin released in Runcorn. It should be noted that current emissions are much lower than those experienced in the past, as shown by metals in sediment from the Mersey estuary over the last century (4).

In collaboration with the former North Cheshire Health Authority (now Warrington and Halton Primary Care Trusts), we undertook preliminary investigations into the health of the population living in the vicinity of these industrial plants in Runcorn. The aim of this study was to determine if there was an excess risk of kidney mortality and morbidity in people living near these industrial plants. Kidney morbidity and mortality was the main concern because of the nephrotoxicants known to be released in the area, and because of the findings of previous investigations (5).

\(^1\) Located on 8 sites (figure 1)
Methods

Mortality was investigated using routinely collected data supplied by the Office for National Statistics (ONS) and analysed using the SAHSU Rapid Inquiry Facility (RIF)(6). Distance from the industrial plants was used as a proxy for exposure.

Standardised Mortality Ratios (SMR) adjusted for socioeconomic deprivation (7) were calculated for deaths from nephritis, nephrotic syndrome and nephrosis (ICD9 580-589) over the years 1981-1999 for populations living in enumeration districts with population weighted centroids falling within 0-2km and 2.01-7.5km of the installations, using the postcode of residence mapped onto those enumeration districts to locate the cases (6) (Figure 1). Expected figures were derived from the North West region population. Enumeration districts are the smallest unit of the national Census and can be aggregated to electoral ward boundaries.

Morbidity was assessed by North Cheshire Health Authority (NCHA), who investigated kidney disease at electoral ward level using routinely collected local hospital admissions data (Patient Information System (PINS), Central Patient Activity Database (CPAD) and Commissioning Minimum Datasets (CMDS)). These data were available from 1990 to 1999, and were used to calculate district age Standardised Admission Ratios (SAR) for non-malignant renal disease as well as kidney cancer (ICD9 580-583 (except 581.8, 582.8 and 583.8), 585-587, 189.0; ICD10 N00-N06, N10, N11.8, N11.9, N15.8, N18, N19, N26, C64) using the population of Warrington and Halton as a reference. Where several hospital episodes involved the same person, that person was counted only once.

Ethical approval for use of routine data has been granted to SAHSU by St Mary’s Local Research and Ethics Committee.
Results

There were 451 deaths from nephritis, nephrotic syndrome and nephrosis in the population living within 0-7.5 km from the industrial plants. There was excess SMR within 7.5km which was higher at 0-2km than 2.01-7.5km, although confidence intervals overlapped (Table 1).

A similar pattern was seen for kidney morbidity (2804 individuals admitted to hospital) when mapped by electoral ward across North Cheshire. (Figure 1). When the ward data were pooled to town level there were excess risks of kidney morbidity in Runcorn and Widnes with SAR of 122 (95% CI 110-136) in males, 136 (95% CI 122-151) in females in Runcorn; and 108 (95% CI 97-120) in males, and 117 (95% CI 104-132) in females in Widnes, in contrast to Warrington (SAR of 91 (95% CI 85-97) in males and 84 (95% CI 78-91) in females), which has far fewer sources of pollution.
Discussion

By using distance from point sources as a proxy for exposure to pollutants from industrial plants we have observed a significant excess of kidney mortality in people living nearest to several polluting sources after adjustment for socio-economic deprivation. Similarly, kidney morbidity appears to be highest in the areas closest to the industrial plants. These trends may be associated with exposure to kidney toxicants, which have been emitted by these plants over the last century.

Ecological analyses and disease mapping are relatively crude methods for establishing health risks associated with point source pollution, especially in this area where historical land contamination and industrial landfill sites may contribute to chemical exposure via pathways other than inhalation. However we have observed a consistent pattern in kidney disease morbidity and mortality from two independent data sources.

Exposure will be affected by occupation (in this area the industrial plants provide a major source of employment) and diet. However, both morbidity and mortality ratios in females were more pronounced than in males (who are much more likely to be occupationally exposed) suggesting that occupation is not a substantial confounder.
Conclusions

We found an excess risk of kidney mortality and morbidity in areas with potential exposure to renal toxicants released from near-by industrial plants. Further work is planned (including more detailed exposure assessment, exploring different exposure pathways) to investigate whether the excess risks are causally related to chemical pollution in the area.
Acknowledgements

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Contributors

S Hodgson, Anna Hansell, L Jarup, M J Nieuwenhuijsen and P Elliott designed, analysed and interpreted the SAHSU study; S Shepperd contributed to the exposure assessment and analysis. T Flute and B Staples designed, analysed and interpreted the NCHA study. S Hodgson wrote the initial draft of the report, which was revised by A Hansell, L Jarup, M J Nieuwenhuijsen and P Elliott.
References:

Table 1: Relationship between proximity to chemical installations and risk of mortality from nephritis, nephrotic syndrome and nephrosis (ICD9 580-589).

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<th>Distance from point source</th>
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<th>Adjusted for age (sex) deprivation</th>
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Figure 1: Standardised admission ratios for kidney disease in the North Cheshire area (shaded areas); 0-2 and 2.01-7.5 km Rapid Inquiry Facility (RIF) exposure areas used in the mortality analysis (circled areas) and location of point sources (16 sources on eight sites).