

## SHORT REPORT

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

S Hodgson, M J Nieuwenhuijsen, A Hansell, S Shepperd, T Flute, B Staples, P Elliott, L Jarup

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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. Excess kidney disease mortality (nephritis, nephrotic syndrome, and nephrosis) was found in the population living within 2 km of the industrial plants (standardised mortality ratio (SMR) in males 131 (95% CI 90 to 185) and females 161 (95% CI 118 to 214)) compared to a reference population (northwest 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 to 124) for males and 126 (95% CI 117 to 137) for females; and in Warrington 91 (95% CI 85 to 97) for males and 84 (95% CI 78 to 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.

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”.<sup>1</sup> 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<sup>2</sup> 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 (located on eight sites; fig 1) in the Runcorn area between 1998 and 2000. All these substances have toxic effects on a range of human organs, including the kidneys.<sup>3</sup> 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 past century.<sup>4</sup>

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.<sup>5</sup>

## METHODS

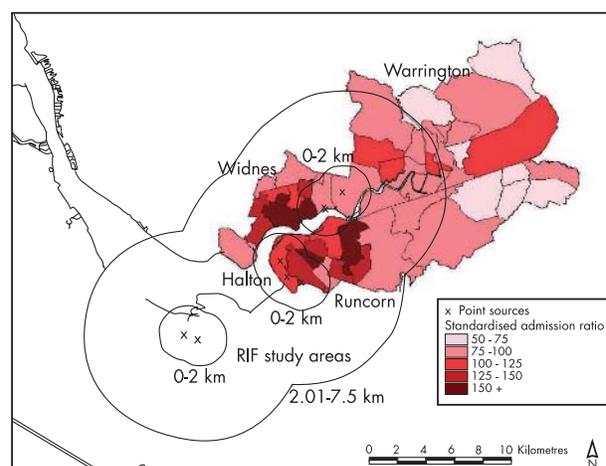
Mortality was investigated using routinely collected data supplied by the Office for National Statistics (ONS) and analysed using the SAHSU Rapid Inquiry Facility (RIF).<sup>6</sup>

Distance from the industrial plants was used as a proxy for exposure.

Standardised mortality ratios (SMR) adjusted for socio-economic deprivation<sup>7</sup> were calculated for deaths from nephritis, nephrotic syndrome, and nephrosis (ICD9 580–589) over the years 1981–99 for populations living in enumeration districts with population weighted centroids falling within 0–2 km and 2.01–7.5 km of the installations, using the postcode of residence mapped onto those enumeration districts to locate the cases<sup>6</sup> (fig 1). Expected figures were derived from the northwest 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, Central Patient Activity Database, and Commissioning Minimum Datasets). 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.



**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).

**Table 1** Relation between proximity to chemical installations and risk of mortality from nephritis, nephrotic syndrome, and nephrosis (ICD9 580–589)

Distance from point source	Sex	Person-years	Adjusted for age (sex)				Adjusted for age (sex) deprivation			
			Obs	Exp	SMR	95% CI	Obs	Exp	SMR	95% CI
0–2 km	Males	390699	32	23.9	134	92 to 189	32	24.4	131	90 to 185
	Females	406581	47	29.3	160	118 to 213	47	29.2	161	118 to 214
	Males and females	797280	79	53.2	149	118 to 185	79	53.6	147	117 to 184
2.01–7.5 km	Males	2941656	166	152.0	109	94 to 127	166	154.4	108	92 to 125
	Females	3041976	206	182.5	113	98 to 129	206	185.9	111	97 to 127
	Males and females	5983632	372	334.5	111	100 to 123	372	340.3	109	99 to 121

## 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 7.5 km which was higher at 0–2 km than 2.01–7.5 km, 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 (fig 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 to 136) in males, 136 (95% CI 122 to 151) in females in Runcorn; and 108 (95% CI 97 to 120) in males, and 117 (95% CI 104 to 132) in females in Widnes, in contrast to Warrington (SAR of 91 (95% CI 85 to 97) in males and 84 (95% CI 78 to 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 past century.

### 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 past century.
- Morbidity and mortality ratios were more pronounced in females than males, suggesting that occupation is not a substantial confounder.

### Policy implications

- Since there was an excess risk of kidney mortality and morbidity in areas with potential exposure to renal toxicants released from nearby industrial plants, further work is needed to investigate whether the excess risks are causally related to chemical pollution in the area.

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 nearby 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.

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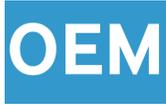
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