Reanalysis of risks of childhood leukaemia with distance from overhead power lines in the UK

Running title: Childhood leukaemia and distance from power lines

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Abstract

Our previous study of childhood leukaemia and distance to high-voltage overhead power lines in the UK has been included in an international pooled analysis. That pooled analysis used different distance categories to us, which has focussed attention on the effect of that choice. We re-analyse our previous subjects, using finer distance categories. In the 1960s and 1970s, when we principally found an elevated risk, the risk did not fall monotonically with distance from the power line but had a maximum at 100-200 m. This weakens the evidence that any elevated risks are related to magnetic fields, and slightly strengthens the evidence for a possible effect involving residential mobility or other socioeconomic factors.

Introduction

There is a substantial body of epidemiological literature suggesting an association between childhood leukaemia and exposure to elevated power-frequency magnetic fields in the home (summarised e.g. by the pooled analyses Ahlbom et al 2000 and Kheifets et al 2010). A number of studies have also looked at proximity to high-voltage overhead power lines. Such power lines are one source of elevated magnetic fields, so raised risks close to power lines could be a manifestation of the association with magnetic fields, but could also be due to any other putative risk factors that vary with proximity to power lines.

We have previously reported (Bunch et al 2014) results from a study in the UK of (in our most recent analysis) 16630 cases of childhood leukaemia from 1962-2008 with matched controls, and proximity of birth address to 132 kV, 275 kV and 400 kV overhead power lines. We found some elevated risks, but there were two features that suggested that these elevations could almost certainly not be attributable to magnetic fields: the elevations we observed extended too far from the lines (out to 600 m), and declined over the decades from the 1960s to the 2000s. Our previous analysis is summarised in Figure 1.

A pooled analysis of studies of childhood leukaemia and distance to power lines (Amoon et al 2018) has recently been completed, incorporating 11 studies including ours. This found a modest and not statistically significant elevation in risk (OR 1.33, 95% CI: 0.92-1.93) within 50 m of the higher-voltage power lines, but did not confirm either the increased risk at larger distances or the decline in risk over five decades. This suggests that these particular features of the UK findings are not present in other countries. But, as well as other countries not reproducing the UK findings, the UK findings themselves are less noticeable in the pooled results than expected given the high proportion of cases they contribute. On investigation, we conclude that this is because of the choice of the distance categories used for the different analyses, and we summarise our observations in this Note.

Materials and methods

We analyse the same subjects using the same statistical techniques as in our previous analysis (Bunch et al 2014). In that analysis, we were scrupulous to use only a-priori distance categories. These were, for the aggregate data over the whole period, 0-50-100 m then 100 m bands. But for our analysis by decade, because each decade would have smaller numbers, we grouped distance categories, and analysed in bands 0-200-600-1000 m. For the present analysis, we combine decades so that we analyse for 1960-1979, 1980-1999, and 2000- (matching the categories used in the pooled analysis Amoon et al). In each of these time-period categories we now analyse by 50 m distance bands.

Results

The results are given in Table 1, and illustrated, for 275 and 400 kV lines (equivalent to the pooled analysis >200 kV analysis) in Figure 2, and for 132 kV lines in Figure 3.

Discussion

It can be seen that for 1960-1979 the risk for 275 and 400 kV lines does not vary monotonically with distance, but is highest in the region of 100-200 m. The risks for 1980-1999 are consistent with a similar but much smaller effect, but, taken on their own, would provide little evidence. The monotonic decrease we previously reported was a consequence of our a-priori choice to make the first distance band 0-200 m, which was large enough to encompass this peak in risk.

The analysis for the 132 kV lines shows a similar effect, albeit less clear cut. This is consistent with our previous analysis, where 132 kV lines showed similar but less pronounced patterns of risk to the 275 kV and 400 kV lines.

The pooled analysis used distance bands 0-50-150-300 m. Figure 2 shows that these cut points split our highest elevated risk across all three distance bands, meaning that the risk elevation is less apparent when analysed in these categories.

This is an instance where adherence to a priori analysis categories, and choice of those categories so as not to be too small, usually regarded as good practice, has obscured the pattern of risk revealed by the data.

The maximum relative risk for 1960-1979 is high – 10 – albeit imprecise, with the lower confidence interval only slightly above 1. It might be thought that a risk this high is implausible, and that this therefore throws doubt on our results, strengthening the possibility that they could be artefactual, perhaps resulting from a bias in the study. However, no such bias has been identified by ourselves or others. Chance seems unlikely given that the dose-response relationship, while not monotonic, is fairly consistent over several adjacent distance bands.

Our previous results had already established that, even if magnetic fields could explain the elevated risk closest to the lines, there had to be another explanation for the elevated risk observed at larger distances. Our new finding strengthens this conclusion and reduces the evidence that magnetic fields play any role in our results.

We previously explored the possibility that our results could be related to population mobility (Swanson 2013). We looked at residential mobility (measured, imperfectly, and for adults only, by how often the name entered for a home on the electoral register changed) and found only modest variations with distance from power lines. However, one reason that we did not place much weight on those findings was because the variation was not monotonic but showed a turning point at 100 m (see Figure 4).

In the light of the new analysis here of our original results, this could now be seen as a strength rather than a weakness. It is not implausible that the pattern of residential mobility, or, through

changing patterns of infectious agents across society, the risk associated with mobility, could have changed on a timescale of decades, though there is no immediate evidence to support this. There are still many problems with suggesting that the pattern of risk we have found could be explained by residential mobility, but we consider that residential mobility, or some related socioeconomic or demographic factor, is possibly the least implausible explanation for our findings that has yet been advanced.

Acknowledgements

The original study (Bunch et al 2014) was performed at the Childhood Cancer Research Group, University of Oxford, now closed, with funding from the charity Children with Cancer UK and other sources acknowledged in that paper. JS worked on this paper as part of his employment at National Grid but no approval was necessary or sought from anyone else at National Grid for the analysis or this paper.

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Figure captions

Figure 1. Risk of childhood leukaemia by distance from overhead lines (275 kV and 400 kV plus 132 kV in areas with full data for >80% of lines). Redrawn from Bunch et al 2014.

Figure 2. Odds ratios for childhood leukaemia by 50 m distance bands. 275 kV and 400 kV lines.

Figure 3. Odds ratios for childhood leukaemia by 50 m distance bands. 132 kV lines in areas with full data for >80% of lines. OR for 50-100 m for <=1979 is actually infinite.

Figure 4. Variation of residential mobility with distance from power line. Redrawn from Swanson 2013.