RESULTS OF A PRELIMINARY STUDY TO TEST THE IRISH SEA PROXIMITY HYPOTHESIS OF BUSBY ET AL

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Background

In an unpublished paper presented to BBC Wales in July 1998 [(1)], the Green Audit Irish Sea Group, using a method of aggregating small geographical areas into bands of increasing distance form the Irish Sea, a reducing gradient of Relative Risks for the incidence of Leukaemia in children under 5yrs for the 16 year period 1974-1989. These Relative Risks, are the ratio of the total observed incidence in each band for this period to that expected from England and Wales rates. Figure 1 of this paper shows a bar chart of Busby's calculated Relative Risks by Band, commencing with a Relative Risk of 4.6 near the coast and reducing with increasing distance from the Irish Sea (although not consistently so).

The clearly stated implication of the paper is that this apparently high Relative Risk near the coast and the apparent reducing gradient is evidence for the effect of exposure to radioactive nucleotides in the Irish Sea originating from Sellafield.

To the best of our knowledge this paper has not been published in any scientific or medical journal. These results have been published in the Guardian on 31st December and presented in a BBC Wales documentary on the 9th February. Moreover these erroneous results continue to be presented on the Low Level Radiation Campaign Web site [(2)] .

Aside from the numerous methodological problems with this paper, we believe that the data being used by these authors is incorrect. They claim to have 138 cases of leukaemia 0-4yrs, on our database we have 48. We suspect strongly that the incidence data supplied by the former WCR in 1995 has been wrongly manipulated by these authors (see appendix for details). Busby et al have been informed of this but continue to publicise these results.

Nevertheless, because of the degree of public concern in Wales regarding the BNFL plant at Sellafield and the suggestion in the paper of a postulated mechanism to cause increased cancer incidence in Wales, Welsh Office have instructed WCISU to carry out a preliminary ecological analysis to test for any evidence of this effect. This is to be carried out not only on Childhood Leukaemia 0-4yrs in response to the Irish Sea Report [(1)], but also Childhood Leukaemia 0-14yrs, Brain Cancer 0-14yrs and All Childhood Malignancies 0-14yrs in response to another report which Busby et al have apparently produced for the Irish Government.

A copy of this report was provided to BBC Wales TV for their documentary on 9th February and reference was made to results contained in it. It has also been mentioned on Radio Cumbria by Dr Busby. It must be noted that WCISU have not yet been provided with a copy of this report. Dr Steward has written to Dr Busby requesting a copy, but in his e-mail reply he states that he can not do this at present without the permission of the Irish Government, by reason of confidentiality.

Method:-

The chosen method is to repeat the analysis of Busby et al [(1)] with a download of data from the current WCISU database. The specification of these Bands in terms of 1991 Wards was supplied directly from Dr Busby. The outline method used here has been checked with him and he has indicated his general agreement with the method.

Definition of Dataset

We extracted cases from the WCISU database (Cancer Registry) :-

1. residential area defined by Busby (excluding industrial South Wales);
2. diagnostic categories:-
   Leukaemia (ICD9 204-208)
   Brain (ICD9 191,192)
   All Malignancies (ICD9 140-208, excluding 173 skin)
3. age-sex groups (M/F 0-4yrs) Leukaemia only; (M/F 0-14yrs) for all diagnostic categories
4. period as analysed by Busby (1974-89).

The completeness of postcoding is 100% for infant Leukaemia (0-4yrs) and very high for the other diagnostic categories (>97.6%). Data was mapped to 1991 Census Wards.

Definition of Areal Bands

Busby et al define Bands of increasing distance from the Irish Sea. They used the obsolete Area Of Residence Codes to four alphanumeric characters of resolution. These represent pre-1974 Local Authority Areas in Wales - Urban Districts, Rural Districts and County Boroughs.

Busby et al volunteered a redefinition of his Bands in terms of 1991 Census Wards. These have been mapped in colour as Figure 2.

It was decided to use these "agreed Bands" - henceforth termed "Busby Bands"

Calculation of Observed Counts

The ED91 postcode to ED lookup file provided by OGSS [(3)] was used to map postcoded data to ED frozen at 1991 Census. These map to 1991 Census Wards and hence to Busby Bands.

Calculation of Expected Counts

The expected rates were calculated by applying the appropriate age specific rates for England and Wales to the estimated populations of the Busby Bands.

Calculation of Relative Risk and Statistical Test

The calculation of the Relative Risks was thus Observed/Expected. The Poisson distribution [4] was used to compute 95% confidence intervals for the estimated Relative Risk. These were graphed for visual inspection and compared with the Busby results. The Null Hypothesis is that the incidence in each Band is that expected if England and Wales rates applied.

A simple test of the Busby hypothesis was carried out for each of the four diagnostic categories. The Null Hypothesis was that the Relative Risk on the Coastal Band (Band A) was equal to the Risk derived from the aggregation of the Inland Bands (Bands B to G). The Alternative Hypothesis then being that the Risk is higher on the Coast. The test statistic used was the ratio of the incidence rates using a single tail test.

Results

Table 1 shows the Relative Risks for the four categories with 95% confidence bands. The individual Bands A to G correspond to Dr Busby's Bands. Band A is nearest the coast and therefore includes the postulated highest risk area. The sum A to G is the area studied by Busby, which is referred to as Rural Wales even though it includes industrial North East Wales. The Area Z is the rest of Wales - urban Wales or more specifically industrial South Wales.

It is clear that we are completely unable to confirm the results of Busby[1] in the sense that no significant differences were obtained for Relative Risks for Leukaemia 0-4yrs in any of the Bands. We also find no evidence of a reducing gradient of risk as one moves away from the coast.

This pattern is followed by the other age group - Leukaemia 0-14yrs and the other diagnostic categories Brain 0-14yrs, All Malignancies 0-14yrs. Figures 3a - 3d portray this graphically.

The overall levels of Childhood Cancer in the areas studied by Dr Busby are not significantly different from those expected from E&W rates. The overall Relative Risk for Leukaemia 0-4yrs in Rural Wales at 0.79 is slightly lower than that expected from E&W rates, as is the Relative Risk for Wales at 0.82.

Moreover this result directly contradicts the published finding of Busby et al, where the overall Relative Risk for Rural Wales is given as 138/52.09 =2.65 - an extreme figure by most standards. We are in broad agreement with the Expected number of leukaemias, he calculates it at 52.09, while we would estimate 61.19. The major discrepancy is in the Observed figure of 138, we have 48 cases.

In terms of the formal test of the Irish Sea effect (agreed with Dr Busby) we examine the ratio of the Risks for Band A versus Bands B-G combined. The results of this test are presented in Table 2 : these are all non-significant. Only the Brain Cancer 0-14yrs is worthy of comment, but with a p-value value >0.10, this is non significant and represents a chance result.

Conclusions

These results do not support the hypothesis of Busby et al. The general level of Relative Risks found in this study for Childhood cancers by Busby Bands are in line with those expected from England and Wales rates. Also no decreasing trend with distance from the coast has been found to exist.

The statistical test, compares the Busby Band A, adjacent to the Irish Sea, a relatively highly populated area with an aggregation of the sparsely populated rural areas inland. This seems to us a sensible first line test of the Irish Sea hypothesis. It has produced no significant results and we accept the Null hypothesis of no effect.

We have to acknowledge that the Areas provided to Busby et al are so large that it is difficult to see how his claim that Bands A represents persons resident within 800m of the Irish Sea can be supported. One would need postcoded point data or data at least down to enumeration district level for this.

In principle, the technique used here, although crude does address the basis hypothesis and Bands are in some crude senses analogous to concentric circles used in other more conventional studies.

Summary

No evidence has been found from this study to support Busby's hypothesis.

References

(1) Busby C, Kocjian, B, Mannion E, Scott Cato M. "Proximity to the Irish Sea and Leukaemia Incidence at ages 0-4 in Wales from 1974-89" Unpublished report of Green Audit Irish Sea Research Group, August 1998
(2) Low Level Radiation Campaign WebSite: http://www.llrc.org/
(3) Office of National Statistics: OGSS User Support Unit. Updated ED:Postcode Directory. ONS Titchfield, Hampshire 1997.
(4) Mehta CR, Patel NR, Statable - Electronic Tables for Statisticians and Engineers version 1.0. Cytel Software Corporation, Cambridge, Massachusetts.

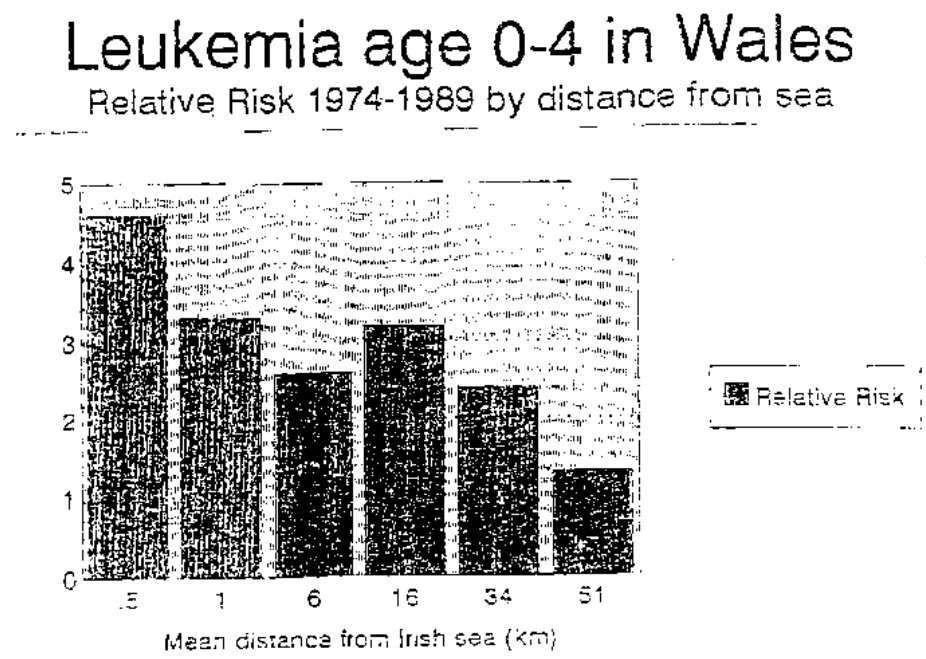
Appendix - Why the Discrepancy?

Dr Busby claims to have found 138 cases of leukaemia 0-4yrs in Rural Wales for the period 1974-89. We have 48 cases on the WCISU database for the same area for this period.

We can only speculate but there is documentary evidence of correspondence between Dr Busby and the former WCR which suggests how this discrepancy could have occurred. We believe that the most likely cause is that, during the input process, "lines were wrapped around" and counts from other age bands were added to the 0-4 age group.

This diagnosis of the problem could be confirmed (or rebutted) by an independent assessment of a two by two matrix of data derived from Dr Busby's original file. This would give, for leukaemia, a count of cases by 5 year age group for each of the small geographical areas existing in Wales at the time of the original data extraction.

FIGURE 1 - Extract From Busby[1] et al.



Relative Risk of leukemia (ICD 204-8) in children aged 0-4 over the period 1974-89 at various distances from the Irish Sea.
(Source: Wales Cancer Registry- Welsh Areas of Residence Datafiles)

Range of distance from sea,<sd> (km)	*Mean distance (Std.dev)*	*Observed cases*	*Expected cases*	*Relative Risk*	*P value significance (Poisson)*	*Number of areas aggregated*
<0.8	*0.5 (0.1)*	*23*	*4.99*	*4.6*	*0.0000*	*14*
0.9<sd<2	*1.0 (0.0)*	*19*	*5.75*	*3.3*	*0.0001*	*10*
2.1<sd<5	*4 (0.0)*	*18*	*6.23*	*2.9*	*0.0001*	*12*
5.1<sd<11	*8.24 (0.66)*	*31*	*13.0*	*2.4*	*0.0000*	*17*
11.1<sd<21	*16.4 (2.8).*	*17*	*5.31*	*3.2*	*0.0000*	*14*
21.1<sd<41	*34.7 (5.8)*	*19*	*7.85*	*2.4*	*0.0005*	*17*
41.1<sd<61	*51.8 (5.8)*	*8*	*5.6*	*1.4*	*0.203*	*19*
51<sd<71	*61.4 (4.8)*	*3*	*3.41*	*0.9*	*0.660*	*14*

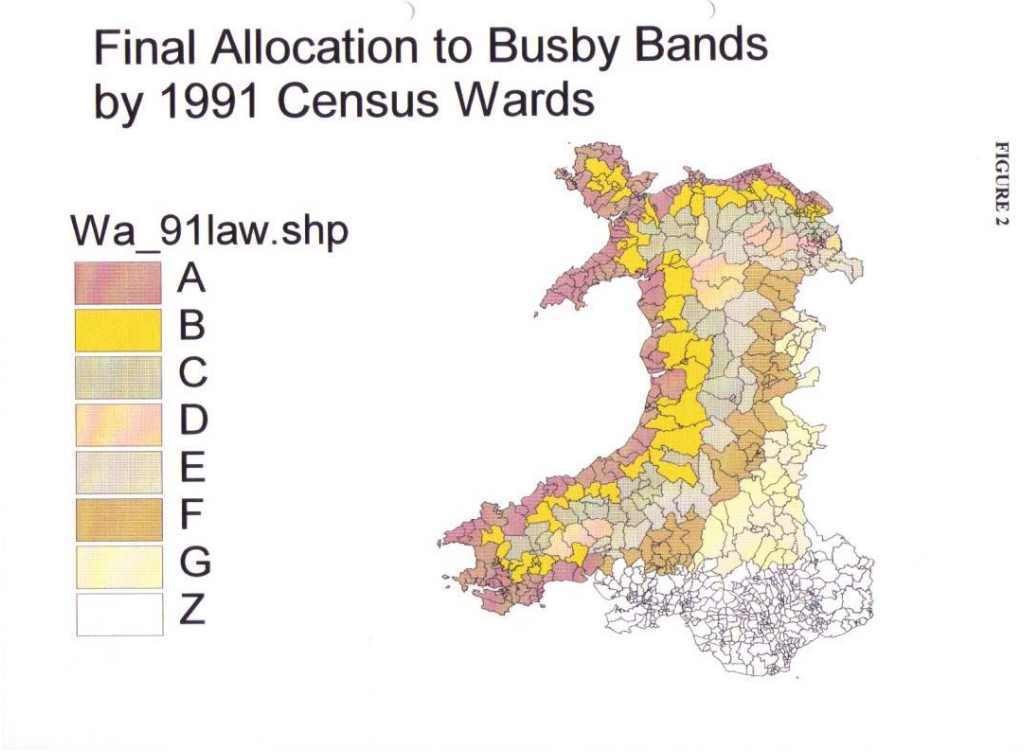

Final Allocation to Busby Bands
by 1991 Census Wards
Wa_91law.shp
A
B
C
D
E
F
G
Z

FIGURE 2

FIGURE 3A

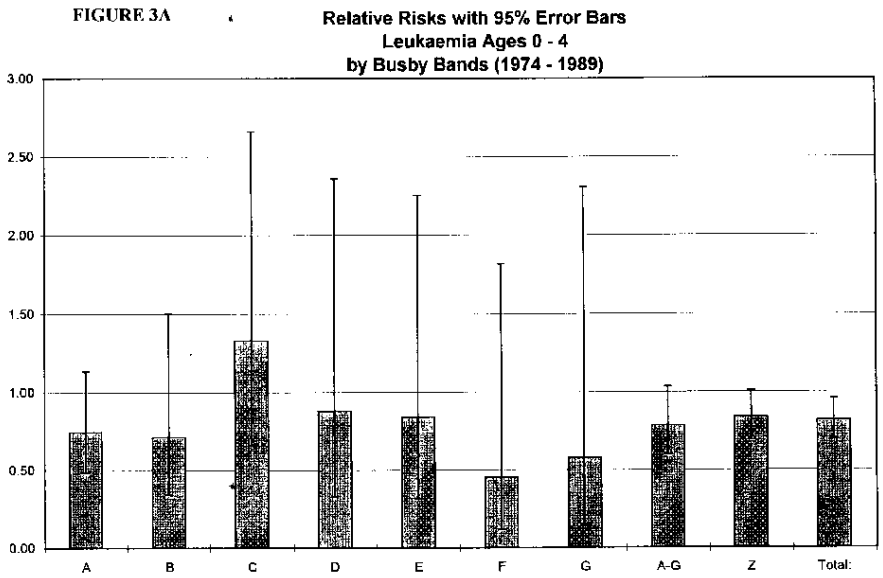


FIGURE 3B

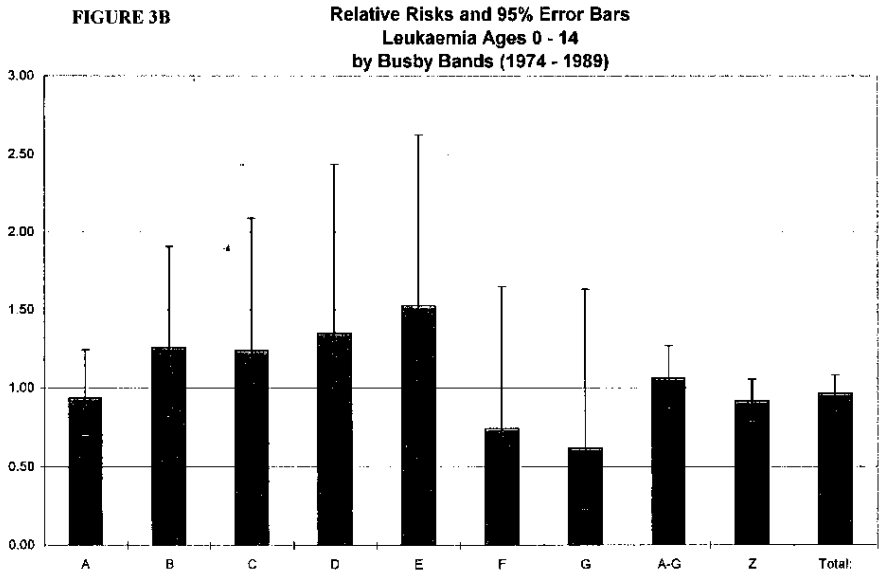


FIGURE 3C

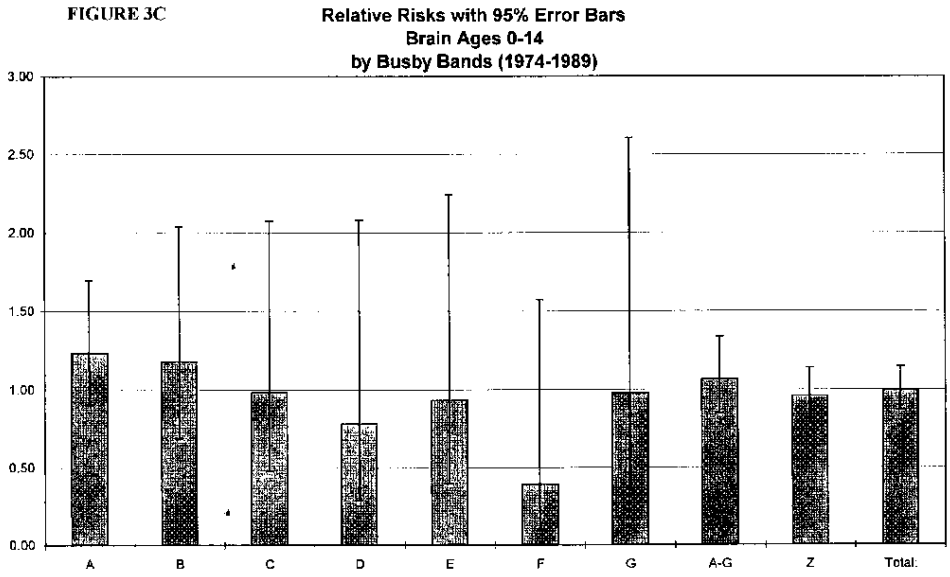


FIGURE 3D