Mesothelioma mortality in Great Britain: how much longer will dockyards dominate?

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Background

Globally, mesothelioma rates have been determined by historic asbestos consumption

Great Britain pioneered the commercial use of asbestos and now has the highest mesothelioma rate in the world

Excellent strength, insulation, and fire-resistant properties of asbestos led it to being heavily used in shipbuilding and maintenance

Dockyard areas are strongly associated with higher rates of mesothelioma, reflecting dockworkers' exposure to asbestos in shipbuilding generally and to amphibole insulation of naval ships in particular

Decline of British shipbuilding and progressive asbestos control regulations would be expected to produce a geographic shift in the distribution of cases in Great Britain; we sought to investigate this quantitatively

Methods - data sources

I combined:

- British Mesothelioma Register data
- ONS Postcode Directory
- ONS mid-year age and sex stratified population estimates for LSOAs
- ONS LSOA to ward and LAD lookup
- Open street map dockyard data
- ONS Open Geography Portal boundary data for England and Wales

Methods - calculations and plotting

To calculate and plot (using EPSG 27700 for map projection):

- SMR for LAD, ward, and LSOA by sex, year, and time period
- Confidence intervals using Byar's approximation
- Local and global autocorrelation using Moran's I with Queen's contiguity row-normalised weights
- Spatial lag using Queen's contiguity row-normalised weights
- Distance to nearest dockyard
- Ordinary least squares regression of distance to dockyard and ward SMR

Methods - coodinate reference systems && administrative units

- EPSG refers to a CRS. What's a CRS?
- There are 348 LADs, 8588 wards, and 34,753 LSOAs in E&W. About 2000 people or 800 households in an LSOA

Methods - Queen's contiguity

Figure 1: Wards within Kensington and Chelsea, our ward in red to illustrate Queen's contiguity.

Methods - Moran's I and spatial lag

- A chessboard would be -1, a piece of paper folded in half one half black one half white would be $+1$, random would be 0
- Is a measure of how correlated variable of interest is with itself across spatial units
- Contingent on weighting scheme used

Results 1

- There were 28947 mesothelioma deaths in England and Wales between 2002 and 2015, 23631(84%) occurred in men and 4644(16%) in women
- The top ten LADs for male mesothelioma SMR all have a dockyard (table 1)
- Of the 348 LADs in England and Wales, 53(15%) have a raised SMR, 81(23%) a low SMR, and 214(61%) non-significant SMR. The majority of LADs with raised SMR, 31(58%) of 53, are contiguous with the coast)

Results 2

Table 1: Male mesothelioma deaths in England and Wales 2002-2015 (top 10 LADs all have a dock)

lad16nm	observed	expected	SMR (95% CI)
Barrow-in-Furness	115.0	34.0	338.0 (279.0-405.7)
North Tyneside	252.0	91.6	275.0 (242.1-311.2)
South Tyneside	161.0	70.4	228.6 (194.6-266.7)
Portsmouth	162.0	72.8	222.5 (189.6-259.5)
Medway	212.0	97.9	216.5 (188.3-247.6)
Hartlepool	89.0	41.2	216.0 (173.5-265.8)
Plymouth	225.0	108.6	207.1 (180.9-236.0)
Fareham	119.0	59.2	201.1 (166.6-240.6)
Newcastle upon Tyne	208.0	105.2	197.7 (171.8-226.5)
Gosport	69.0	36.4	189.4 (147.3-239.7)

Results 3

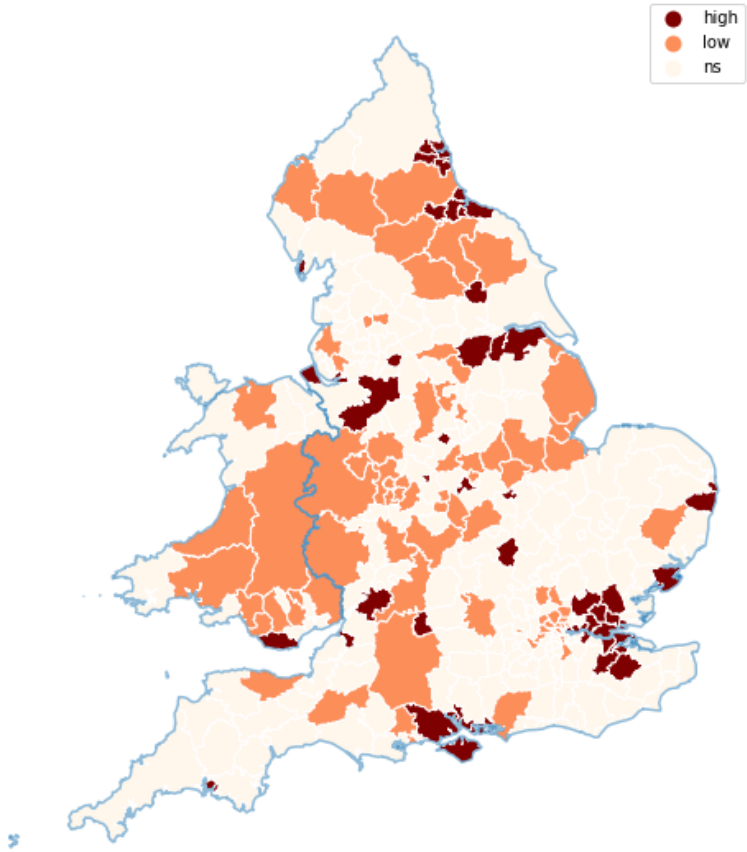

Figure 2: Local authority district level male mesothelioma standardised mortality rates 2002-2015.

Results 4

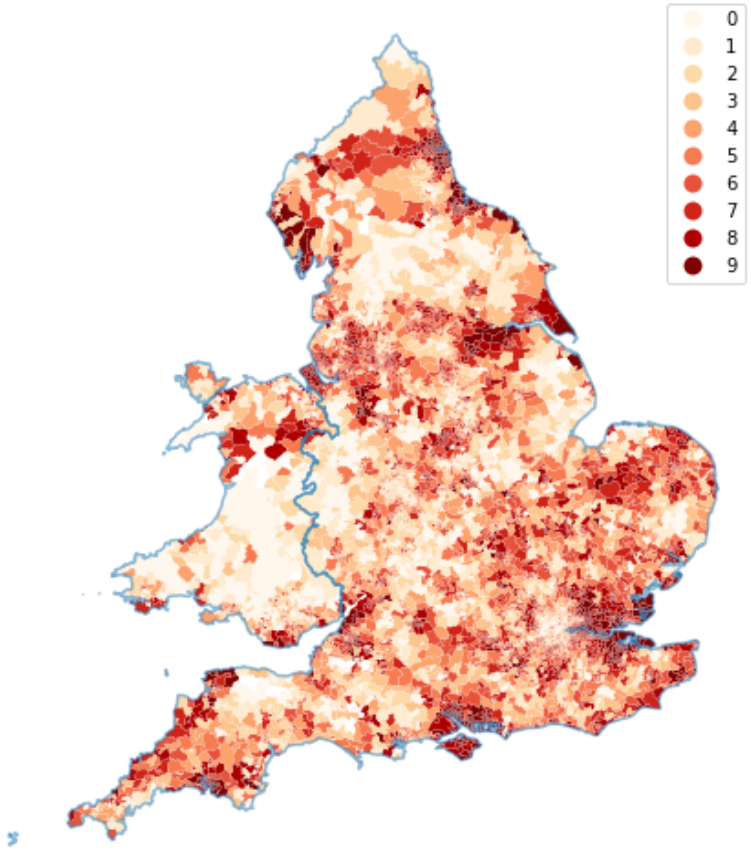

Figure 3: Ward-level male mesothelioma standardised mortality rates 2002-2015, spatial lag deciles.

Results 5

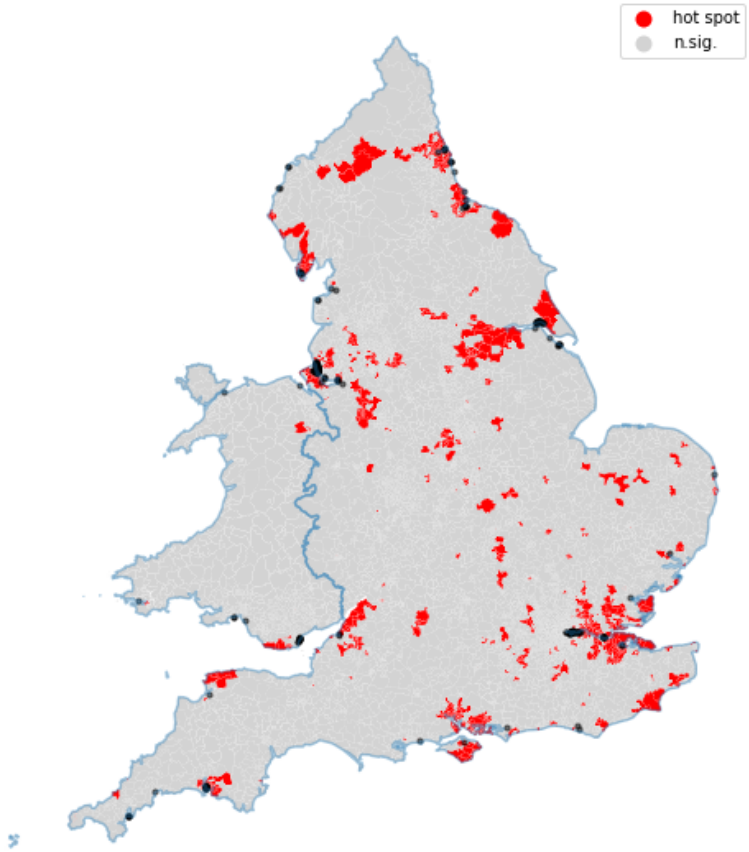

Figure 4: Ward-level male mesothelioma hotspots 2002-2015 data, dockyards shown in black. Hotspots identified using LISA.

Results 6

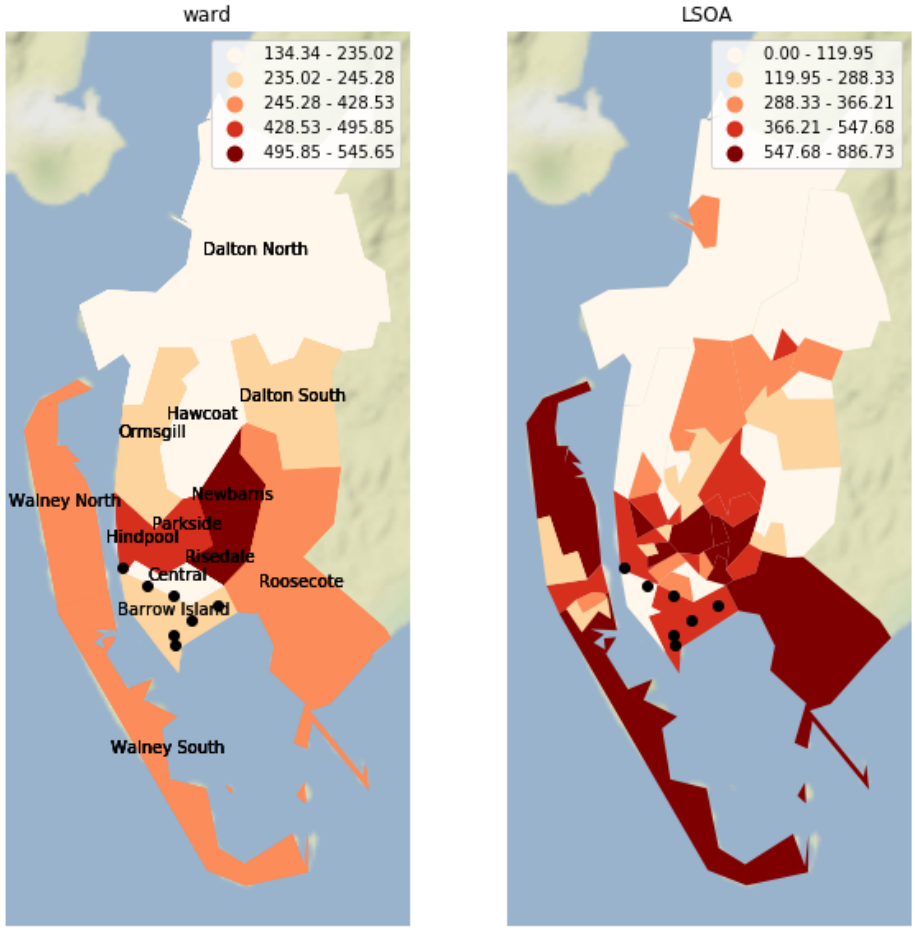

Figure 5: Choropleths of male mesothelioma SMR in Barrow-in-Furness 2002-2015 at ward and LSOA level, dockyards shown in black.

Results 7

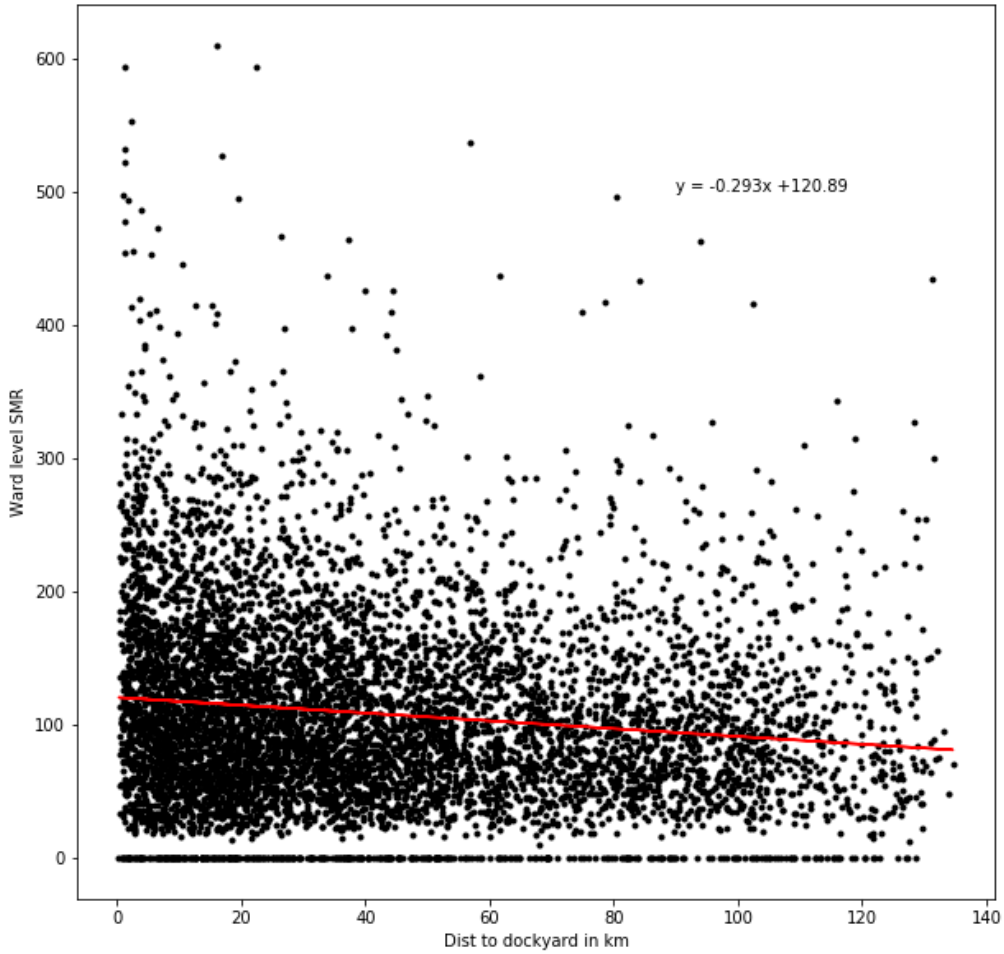

Figure 6: Distance to dockyard and ward-level male mesothelioma standardised mortality rate.

Results 8

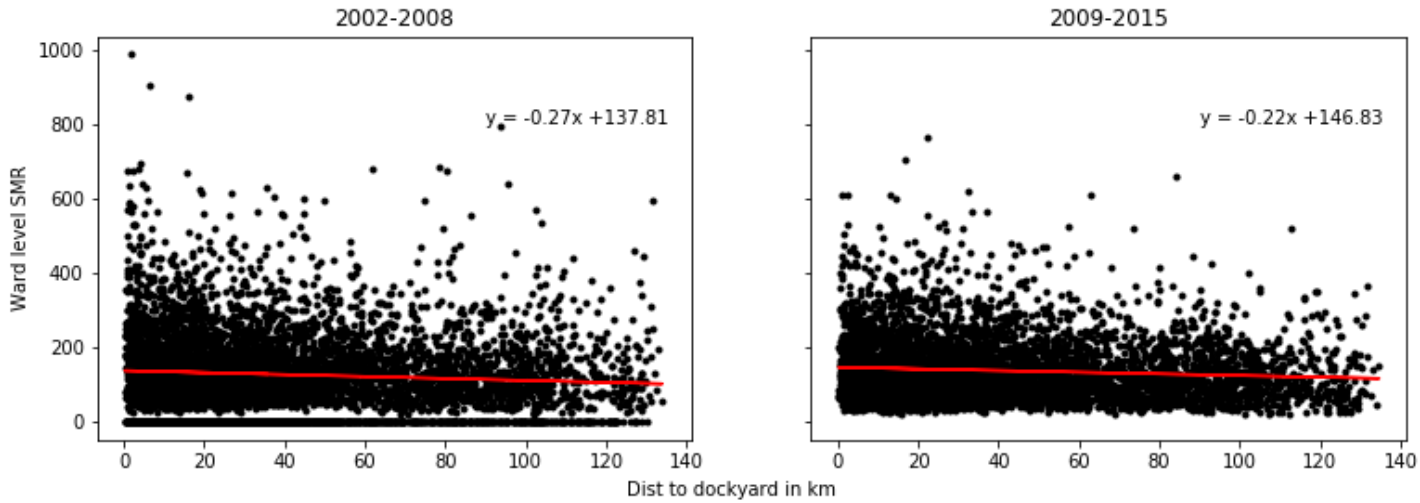

Figure 7: Distance to dockyard and ward-level male mesothelioma standardised mortality rate.

Results 9

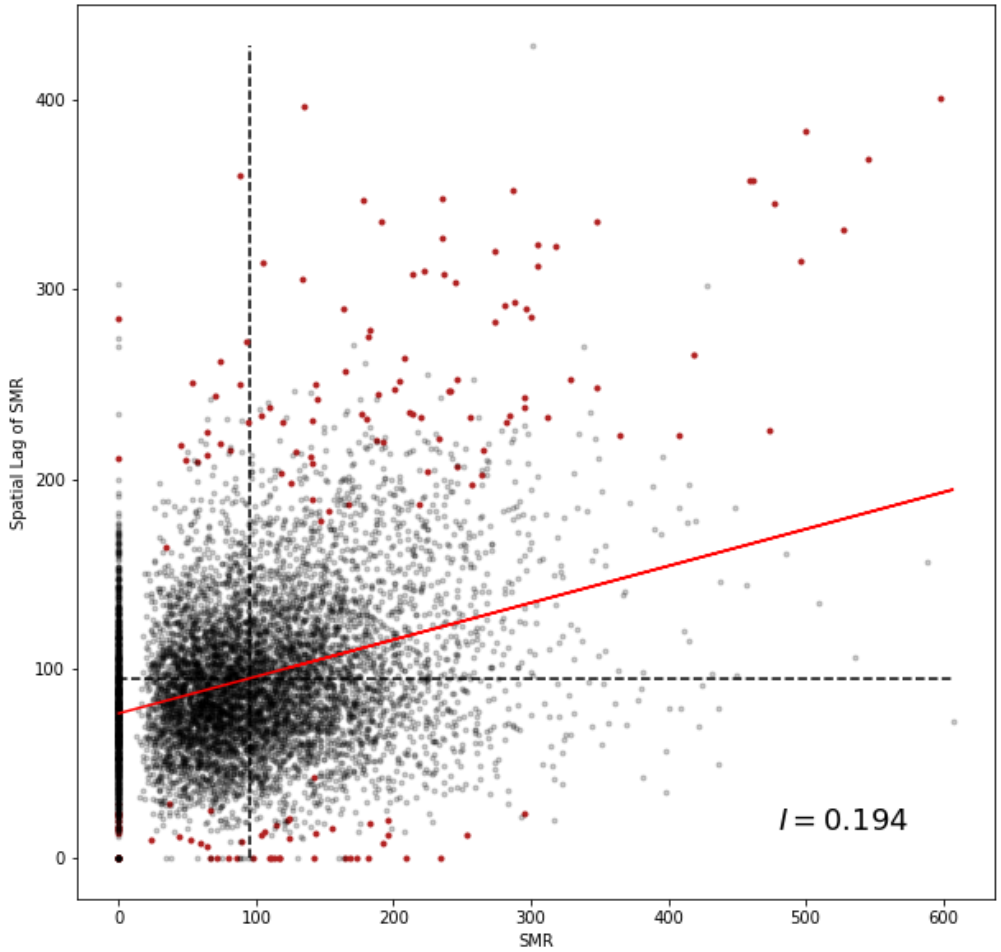

Figure 8: Moran scatter plot of ward-level male mesothelioma standardised mortality rate data.

Results 10

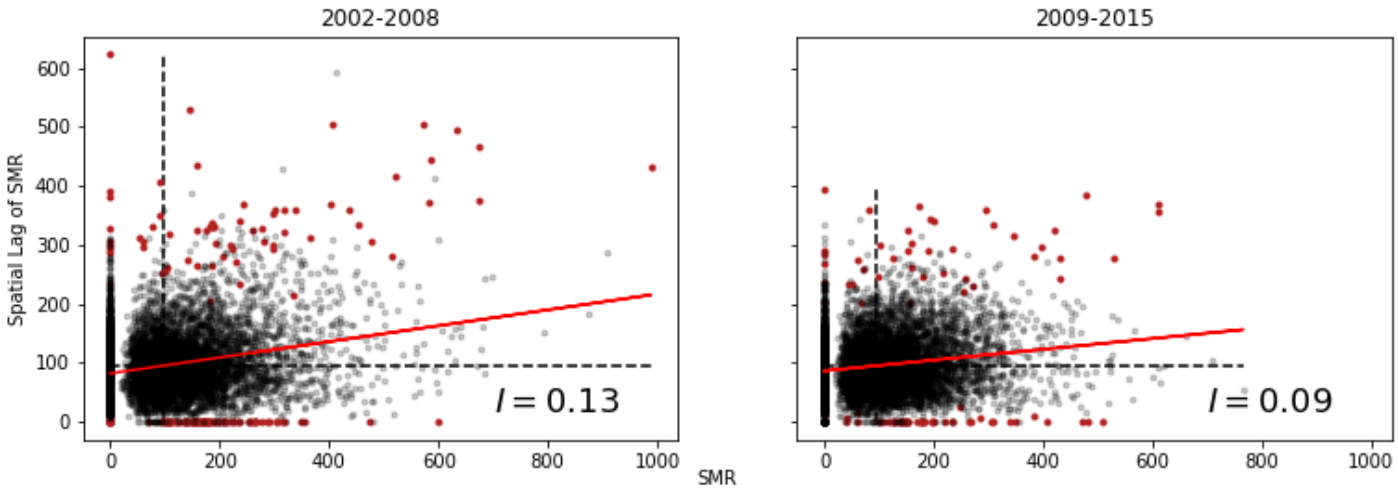

Figure 9: Moran scatter plot of ward-level male mesothelioma standardised mortality rate data.

Discussion

Between 2002 and 2015, at LAD level, areas with the highest male mesothelioma SMR contain naval dockyards and other sites of naval ship construction and maintenance, a pattern which is repeated at ward and LSOA level

Female mesothelioma SMR is also heavily associated with naval dockyards and other sites of naval ship construction but a contribution from the manufacture of insulation materials, textiles, and cement is evident from London boroughs and adjacent areas (data not shown)

Average distance to nearest dockyard and ward-level male mesothelioma showed a small negative linear relationship in which each kilometre distance from a dockyard was associated with an approximate fall in SMR of 0.3

This effect is likely to have been diluted by the inclusive approach used to select dockyards and the fact that all dockyards are given equal weight in the analysis

Discussion (continued)

Measured formally using Moran's I male mesothelioma SMR correlates with itself through space. This is expected for a rare disease like mesothelioma where there is a strong effect of focal exposure sources such as dockyards

Interestingly, Moran's I for male mesothelioma SMR is falling overtime which suggests that mesothelioma deaths are becoming more dispersed. This would be consistent with a decline in the proportion of mesothelioma risk arising from focal exposure sources

Geospatial methods relatively underused in occupational epidemiology. Have (hopefully) shown can be of value

Discussion - limitations

Use of residence obtained from death certificate data

Variation in exposure between dockyards

Confounding by non-dockyard asbestos exposure sources

Conclusion

Mesothelioma deaths are becoming more dispersed, while dockyards remain strongly spatially associated the strength of this association is falling. It is likely that dockyards will no longer dominate mesothelioma mortality in the next 10-20 years and the asbestos legacy latent in the built environment may become a more important exposure source.

Questions && Feedback

Ask away!