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HEALTH IMPACTS OF AIR POLLUTION IN BIRMINGHAM

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WM-Air - Clean Air Science for the West Midlands (wm-air.org.uk) is a NERC funded initiative, led by the University of Birmingham. The programme, in collaboration with over 20 cross sector partners, applies environmental science expertise to support improvement of air quality, health, environmental and economic benefits, in the West Midlands.

Research conducted by WM-Air has quantified the impacts of air pollution in Birmingham on a range of health conditions – including asthma, heart disease, stroke, lung cancer and risk of early death. Calculations were performed using the Air Quality Life Assessment Tool (AQ-LAT) developed within the WM-Air programme. For a detailed description of methods and to download the tool visit https://wm-air.org.uk/project/health/.

Health Impacts of Air Pollution in Birmingham - Summary

Our research shows that each year air pollution in Birmingham contributes to:

- **720 (between 561 and 802) early deaths, equivalent to 7900 lost years of life** among the city population[1]
- **900 (between 312 and 1360) new asthma cases** among children and adults
- The highest proportion of disease cases and early deaths attributable to air pollution is distributed within 40 wards clustered around the **city centre**

[1] **Early deaths are estimated using the concentration-response function (CRF) in the COMEAP recommendation for quantification of mortality associated with long-term exposure to air pollution (COMEAP, 2022a). Ranges are estimated using the CRF reflective of the upper and lower bound of the confidence interval. The recommended CRF is 1.08 (95% CI: 1.06, 1.09) per 10µg/m^3 increase in annual average $PM_{2.5}$. Life years lost is estimated by multiplying the number of attributable deaths by the PHE (2014) estimate of 10.97 years of life lost for each air pollution related death for the Birmingham area.**

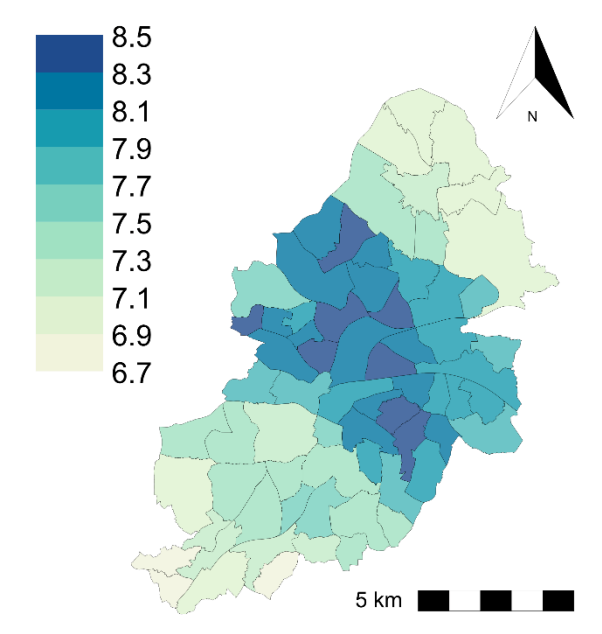
How are health impacts of air pollution distributed across the city?

Electoral wards with the highest proportion mortality attributable to air pollution exposure are in the central area of Birmingham, as shown in the ward level map[2,3] (Fig 1). This patterning largely reflects the higher air pollution levels in the central city area. Wards with the lowest proportions of air pollution related deaths are situated in north and southern-wards (Tables 1a and 1b).

Wards with the highest and lowest absolute number of deaths attributable to air pollution in 2019 are shown in Tables 2a and 2b[4]. Whilst the proportion of deaths related to air pollution is higher in central Birmingham, wards with larger populations will on average have more deaths, due to more people being exposed to air pollution. Area level health determinants, reflected in existing comorbidities and mortality rates also play a role in influencing the total number of deaths.

Age structure of the local population is also important. Wards with a higher proportion of the population aged over 65 years will have more deaths each year than those wards with a younger population, e.g. Sutton Walmley & Minworth (17% over 65), Sutton Vesey (16%), Sheldon (14%), and Bourneville & Cotteridge (14%).

Fig 1. **Annual % (attributable) mortality associated with air pollution exposure in Birmingham (2019)**



Wards with the fewest annual deaths generally have smaller population sizes. The exceptions here appear because of relatively small proportions of the population aged over 65 years, e.g. Bordesley & Highgate (3%), Nechells (4%), and Newtown (4%). The number of deaths can also be converted into total life years lost, shown in the right-hand column of **Appendix 1**[1].

Table 1a and 1b. **Air pollution related deaths (attributable mortality) by ward (2019)**[5]

(a) 10 wards with highest % mortality attributable to air pollution (2019)

No.	Ward	Mortality
1	Tyseley & Hay Mills	8.5%
2	Holyhead	8.4%
3	Aston	8.4%
4	Gravelly Hill	8.4%
5	Alum Rock	8.4%
6	Newtown	8.3%
7	Small Heath	8.3%
8	Kingstanding	8.3%
9	Nechells	8.3%
10	Stockland Green	8.3%

(b) 10 wards with lowest % mortality attributable to air pollution (2019)

No.	Ward	Mortality
1	Rubery & Rednal	6.7%
2	Frankley Great Park	6.8%
3	King's Norton South	6.9%
4	Sutton Mere Green	6.9%
5	Longbridge & West Heath	6.9%
6	Sutton Roughley	7.0%
7	Bartley Green	7.0%
8	Sutton Four Oaks	7.0%
9	Sutton Reddicap	7.1%
10	Sutton Walmley & Minworth	7.1%

[2] This percentage is known as the 'attributable mortality' due to air pollution exposure.
[3] See Appendix for full data.
[4] Note: numbers of absolute deaths are primarily determined by ward population size and to a lesser extent the age profile, comorbidities, and air pollution exposure burden.
[5] Note: differences between attributable mortality are small at ward level, this is because the risk of mortality is greatest for fine Particulate Matter ($PM_{2.5}$) exposure which has limited ward-level variation.

Which diseases are caused by air pollution exposure in Birmingham?

The number of new disease diagnoses caused by air pollution exposure each year in Birmingham is shown in Fig 2. These are known as 'attributable' disease cases. Asthma is the disease with the highest number of attributable cases[6]. Asthma is more strongly associated with NO_2 exposure therefore the proportion of population having a new asthma diagnosis attributable to air pollution is higher than the Birmingham average in areas of very high NO_2 concentrations, including Ladywood, Bordesley & Highgate, Newtown, and Nechells wards. Additionally, as asthma is commonly diagnosed in childhood, those wards with younger populations, e.g. Heartlands (38% ≤ 18 years old), Alum Rock 36%), Bordesley Green (36%), Small Heath (36%) also have more attributable asthma cases than the Birmingham average.

Conditions included in this analysis were those with evidence for causal links with air pollution exposure, based upon recommendations of the Committee on the Medical Effects of Air Pollutants (COMEAP, 2022b). A more recent COMEAP review concluded that it is likely air pollution is associated with a decline in mental ability and dementia in older people (COMEAP, 2022c). However, COMEAP has not made recommendations on how to estimate the effects of air pollution on dementia and therefore we do not include this outcome in the AQ-LAT model or this current analysis. Emerging evidence also suggests links between air pollution and metabolic disorders, obesity, other cancers, and adverse birth outcomes (RCP, 2016)

Table 2a and 2b. **Air pollution related deaths (attributable deaths) by ward (2019)**

(a) 10 wards with highest mortality attributable to air pollution (2019)

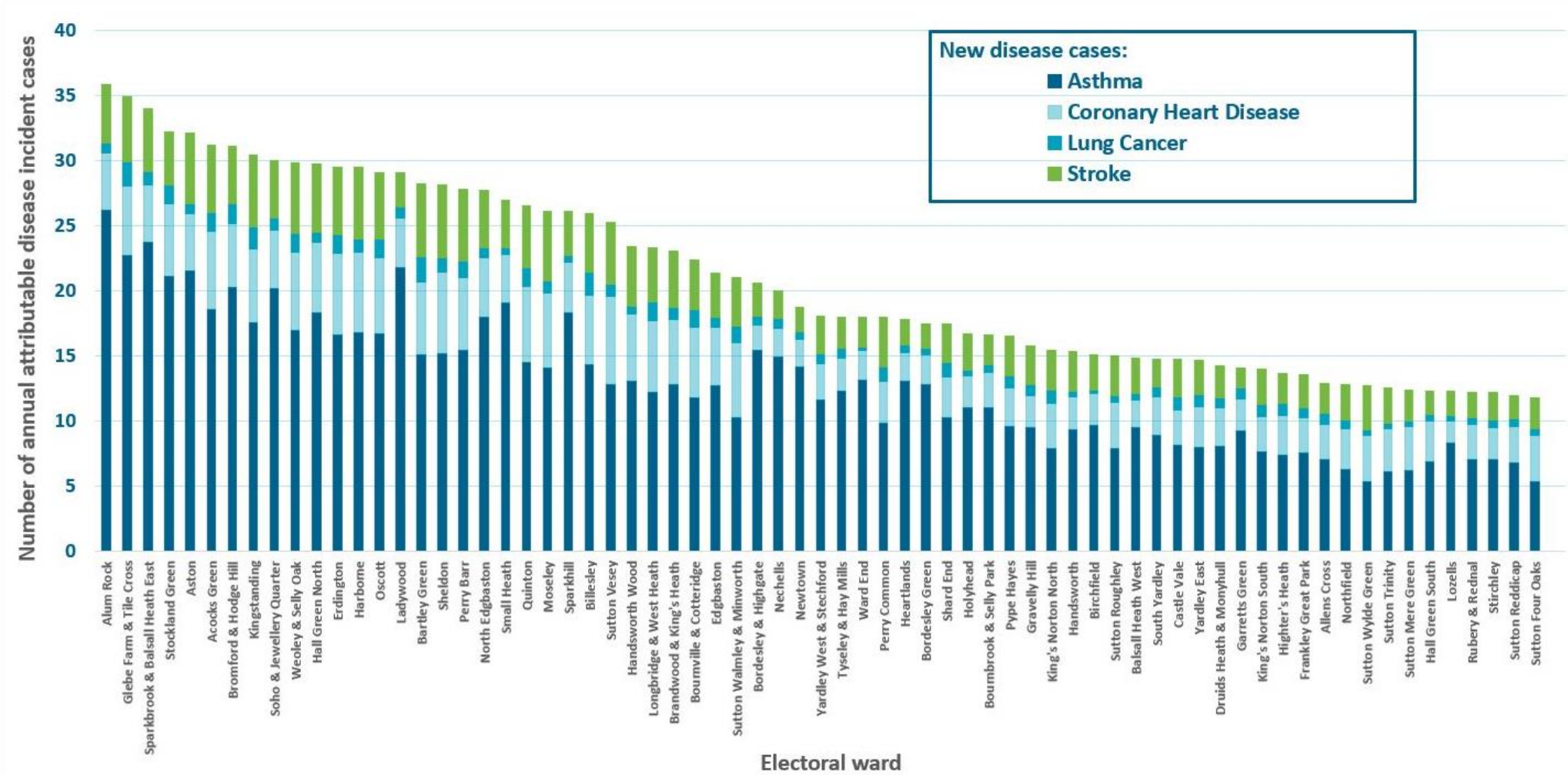
No.	Ward	Deaths	Population
1	Sutton Vesey	19	19572
2	Weoley & Selly Oak	18	24256
3	Harborne	18	24346
4	Erdington	18	20811
5	Sheldon	17	19835
6	Acocks Green	17	24214
7	Sutton Walmley & Minworth	16	15894
8	Quinton	16	20393
9	Oscott	15	20158
10	Bournville & Cotteridge	15	17991

(b) 10 wards with lowest mortality attributable to air pollution (2019)

No.	Ward	Deaths	Population
1	Lozells	4	9788
2	Bordesley & Highgate	5	16038
3	Nechells	5	16454
4	Newtown	5	15174
5	Ward End	6	13708
6	Balsall Heath West	6	12006
7	Bordesley Green	6	12824
8	Gravelly Hill	6	10783
9	Handsworth	6	12511
10	Birchfield	6	12481

[6] **Note: the high burden is because asthma is a relatively common condition and is causally associated with both nitrogen dioxide (NO_2) and particulate matter ($PM_{2.5}$) exposure.**

Fig 2. **Annual (incident) disease cases associated with air pollution in 2019**[7]



[7] **Incident cases refers to the occurrence of new diagnoses of disease in the city population over a defined time period (one year).**

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Statement concerning accuracy and limitations & use of preliminary datasets

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Appendix 1

Annual burden of morbidity and mortality attributable to air pollution in Birmingham (2019)							
Ward	Mortality	Asthma	CHD	Lung Cancer	Stroke	Mortality	Life-years lost
Acocks Green	17	19	6	1	5	7.96%	186
Allens Cross	8	7	3	1	2	7.16%	84
Alum Rock	12	26	4	1	4	8.36%	130
Aston	11	22	4	1	5	8.43%	125
Balsall Heath West	6	10	2	0	3	7.69%	62
Bartley Green	14	15	6	2	6	6.97%	153
Billesley	15	14	5	2	5	7.47%	162
Birchfield	6	10	2	0	3	8.04%	67
Bordesley & Highgate	5	15	2	1	3	7.95%	50
Bordesley Green	6	13	2	1	2	8.17%	66
Bournbrook & Selly Park	8	11	3	1	2	7.48%	83
Bournville & Cotteridge	15	12	5	1	4	7.31%	169
Brandwood & King's Heath	12	13	5	1	4	7.57%	135
Bromford & Hodge Hill	14	20	5	2	4	7.95%	151
Castle Vale	8	8	3	1	3	7.73%	84
Druids Heath & Monyhull	8	8	3	1	2	7.17%	86
Edgbaston	13	13	5	1	3	7.29%	141
Erdington	18	17	6	1	5	8.00%	198
Frankley Great Park	6	8	3	1	3	6.76%	68
Garretts Green	7	9	3	1	2	7.99%	74
Glebe Farm & Tile Cross	14	23	5	2	5	7.98%	151
Gravelly Hill	6	10	2	1	3	8.42%	67
Hall Green North	15	18	5	1	5	7.84%	164
Hall Green South	8	7	3	1	2	7.42%	88
Handsworth	6	9	3	0	3	8.16%	67
Handsworth Wood	13	13	5	1	5	7.66%	144
Harborne	18	17	6	1	5	7.48%	199
Heartlands	6	13	2	1	2	8.15%	71
Highter's Heath	8	7	3	1	2	7.41%	93
Holyhead	7	11	3	0	3	8.43%	79
King's Norton North	9	8	3	1	3	7.26%	103
King's Norton South	7	8	3	1	3	6.86%	71
Kingstanding	15	18	6	2	5	8.30%	165
Ladywood	9	22	4	1	3	7.86%	94

Ward	Mortality	Asthma	CHD	Lung Cancer	Stroke	Mortality %	Life-years lost
Longbridge & West Heath	14	12	6	1	4	6.94%	156
Lozells	4	8	2	0	2	8.13%	45
Moseley	15	14	6	1	5	7.42%	167
Nechells	5	15	2	1	2	8.29%	57
Newtown	5	14	2	1	2	8.33%	58
North Edgbaston	11	18	5	1	4	7.81%	122
Northfield	8	6	3	1	3	7.18%	92
Oscott	15	17	6	1	5	8.21%	170
Perry Barr	15	15	6	1	5	8.14%	164
Perry Common	8	10	3	1	4	8.14%	92
Pype Hayes	8	10	3	1	3	8.08%	87
Quinton	16	15	6	1	5	7.49%	172
Rubery & Rednal	7	7	3	1	2	6.74%	81
Shard End	9	10	3	1	3	7.73%	94
Sheldon	17	15	6	1	6	7.87%	191
Small Heath	10	19	4	0	4	8.32%	109
Soho & Jewellery Quarter	11	20	4	1	4	8.13%	121
South Yardley	7	9	3	1	2	8.23%	78
Sparkbrook & Balsall Heath East	11	24	4	1	5	8.14%	123
Sparkhill	10	18	4	0	3	7.95%	112
Stirchley	6	7	2	1	2	7.63%	68
Stockland Green	14	21	6	1	4	8.26%	159
Sutton Four Oaks	11	5	4	0	2	7.00%	121
Sutton Mere Green	11	6	3	0	2	6.94%	118
Sutton Reddicap	8	7	3	1	2	7.07%	82
Sutton Roughley	10	8	4	1	3	6.97%	115
Sutton Trinity	10	6	3	0	3	7.18%	115
Sutton Vesey	19	13	7	1	5	7.42%	205
Sutton Walmley & Minworth	16	10	6	1	4	7.09%	174
Sutton Wylde Green	10	5	4	0	3	7.45%	113
Tyseley & Hay Mills	6	12	3	1	2	8.49%	70
Ward End	6	13	2	0	2	8.17%	60
Weoley & Selly Oak	18	17	6	1	5	7.32%	201
Yardley East	9	8	3	1	3	7.99%	99
Yardley West & Stechford	7	12	3	1	3	8.03%	82