Air Quality
Wokingham Local Authority Draft

Introduction

Poor air quality is a significant public health issue. It has been estimated that removing all fine particulate air pollution would have a bigger impact on life expectancy in England and Wales than eliminating passive smoking or road traffic accidents[1]. The economic cost from the impacts of air pollution in the UK is estimated at £9-19 billion every year[2]. This is comparable to the economic cost of obesity (over £10 billion)[3] A study in the Lancet found that particulate matter air pollution was the 5th highest mortality risk factor in 2015, causing 4.2 million deaths (7.6% of global deaths)[4]. In the UK, particulate air pollution is thought to be the cause of nearly 29,000 deaths in 2008 with an associated loss of 340,000 life years[5].

Pollutants with the greatest current impact on public health are considered to be particulate matter 2.5 (PM 2.5), ozone and nitrogen dioxide; with PM 2.5 having the strongest epidemiological link to health outcomes. Damage occurs across a lifetime, from a baby's first weeks in the womb all the way through to the years of older age[6].

These pollutants are produced by construction sites and machinery, farming, shipping, home and commercial heating, aircraft emissions, industrial processes and road transport. The standards for air quality are currently set in English law at the European Union (EU) standard through the Air Quality Standards Regulations (England) 2010 with equivalent legislation in the devolved areas of Wales, Scotland and Northern Ireland. It should be noted that this may become subject to change with the confirmation that the United Kingdom has now triggered the process for leaving the EU.
(Source- Air Quality Standards Regulations 2010)

Ozone is a molecule constructed of oxygen atoms. It forms a natural barrier, known as the 'Ozone Layer' in the upper atmosphere protecting the Earth from the Sun's damaging ultraviolet radiation. However, at lower atmospheric levels ozone exposure represents a substantial risk to the health of the UK population and vegetation. Ozone is a secondary pollutant with most of its production coming from chemical reactions between other anthropogenic emissions rather than being directly emitted. This means ozone concentrations are highly variable due to prevailing atmospheric conditions, availability of its precursors and the amount of sunlight. As a result, ozone presents a difficult control problem because as not much is directly emitted it can be difficult to regulate the processes that lead to its creation. Ozone can travel long distances in the atmosphere with the result that emissions from mainland Europe can influence ozone concentrations in the UK, contributing to the control and regulation issue. This enforces the importance of measuring ambient air quality and not just emissions. Whilst rural ozone levels have remained relatively stable from 1991-2015, urban background ozone has been increasing since 1987 with a previous downward trend from 2006- 2011 reversed in 2011. There is a high degree of variability year on year making it difficult to ascertain a long term trend.
(Source – DEFRA Air Quality 1987-2016, Ozone in the United Kingdom, Air Quality Expert Group, DEFRA 2009, Report on Mortality and Hospital Admissions caused by Ozone, COMEAP 2015, and Hemispheric Transport of Air Pollution, ECFE 2010)

Nitrogen-based compounds (NOx) are also pollutants, particularly nitric oxide (NO) and nitrogen dioxide (NO2). NOx is produced when hydrocarbons such as petrol, diesel or natural gas are burned and, unlike ozone, is a direct emission. NOx pollutants are one of contributory precursors for ground level ozone formation. There is evidence that high levels of nitrogen dioxide is a respiratory irritant and, over a long period of time, affect how well our lungs work, particularly those with asthma. Studies have suggested it may contribute to impaired lung development and recurrent respiratory illnesses in children. NO2 can also adversely affect vegetation.

An important factor to consider is the interaction between pollutants and the unintended effects of reducing one pollutant on another. Ozone reacts with NO to form NO2 and oxygen. The amount of NO2 is, therefore, dependant on the amount of ozone brought in by the weather conditions. An unintended consequence of reducing NOx emissions is an increase in ozone concentration as there is less NO to react with the ozone and remove it from the air.

(Source – Nitrogen Dioxide in the UK, Air Quality Group, DEFRA 2004, Health effects of Nitrogen Dioxide, COMEAP 2014 and Air Quality: A Briefing for Directors of Public Health, PHE 2017)

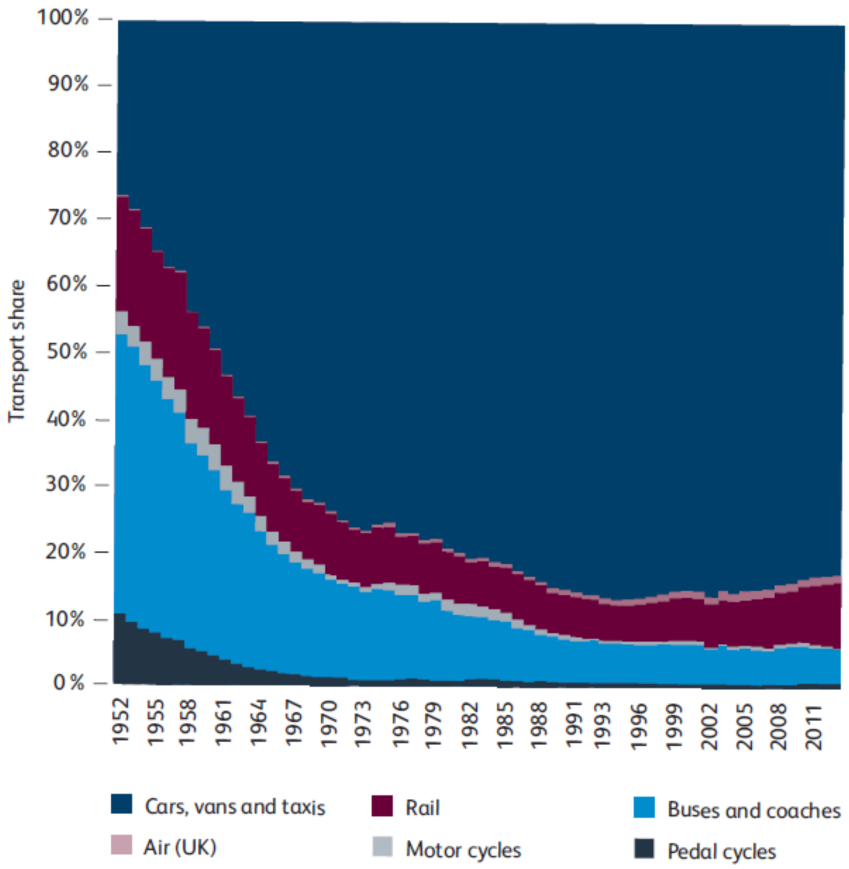
Exposure to ambient particulate matter pollution, particularly to small particles known as PM 2.5, is associated with increased risks of death and ill health. PM2.5 are tiny particles, less than <2.5 μm (<2.5 millionths of a metre) across and largely invisible. The size of particles is important because fractions of PM <10 μm in diameter tend not to be filtered out by the nose and fractions <2.5 μm are able to penetrate deep into the lungs. Very small particles from 0.1 to 0.001 μm are so small that they can pass into the circulation[2]. The majority of data available is related to PM, as it has the strongest epidemiological link to health outcomes.

PM 2.5 is linked to respiratory diseases and is a possible cause of exacerbations of chronic lung diseases such as asthma or chronic obstructive pulmonary disease, but is also linked to cardiovascular diseases leading to myocardial infarctions and strokes[4].

Reducing air pollution requires action to reduce domestic emissions as well as working closely with international partners to reduce transboundary emissions (pollutants blown over from other countries) which, at times, can account for a significant proportion of pollutant concentrations experienced in the UK (for example, it is estimated that sources outside of the UK account for 35-50% of measured ambient particulate matter concentrations).

(Source – Air Pollution in the UK 2015, DEFRA, Air Quality: A Briefing for Directors of Public Health, PHE 2017 and Mortality effects of Long-Term Exposure to Particulate Air Pollution in the UK, COMEAP 2010)

Figure 1 – Comparison of use of different modes of transport over the last 60 years



(https://www.rcplondon.ac.uk/projects/outputs/every-breath-we-take-lifelong-impact-air-pollution)

In contrast to the growth in motorised traffic (
Figure 1), active transport such as walking and cycling has declined progressively since the 1950s. Primary emissions from road traffic, including the non-exhaust component, make a significant (about 30-50%) contribution to the urban background increment of PM 2.5 above rural concentrations (especially diesel engines)[6]. These produced particles affect everyone in the vicinity, including those driving.

Continued focus on controlling urban air pollution through technical measures to reduce vehicle exhaust components provides less benefit for public health than focusing on measures that increase active travel and public transport. Many studies have underlined the public health benefits of increased active travel by both cycling and walking, with the benefits outweighing the increased risks from accidents and air pollution exposure by a factor of at least ten[3].

The importance of the effect of air pollution on public health is reflected by the inclusion of an indicator of mortality associated with air pollution in the Public Health Outcomes Framework for England (PHOF)[7].

Facts, Figures, Trends

Please note, there are two different methods of PM 2.5 calculations used to produce this report as the sources of data are different. The methods are:

1. PM 2.5 data from PHOF is determined by modelling and use estimates of the anthropogenic (human-made) component of these concentrations on those 30+
2. Ambient particulate matter pollution data from GBD (Global burden of disease) uses models of total PM 2.5 estimates

PHOF indicator 3.01 is the fraction of preventable mortality that is estimated to be attributable to human-made particulate air pollution; estimates of this fraction for Berkshire LA's are shown in **Error! Reference source not found.**.

Table 1 - Estimations of mortality by PM 2.5 concentrations (2014)

Area	England	Wokingham
Mean anthropogenic PM2.5	**9.1**	**8.9**
PHOF 3.1 Attributable fraction of deaths (%)	**5.1**	**5.1**
Attributable deaths	**24,170**	**58**
Associated life years lost	**290,036**	**695**

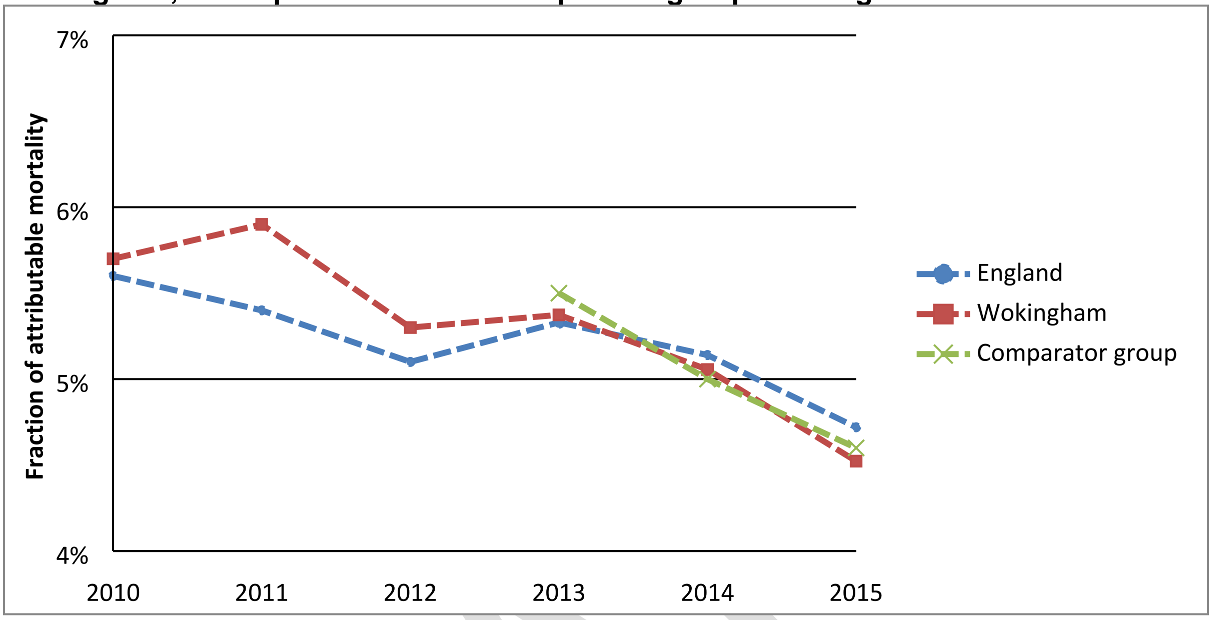
(Source - https://uk-air.defra.gov.uk/data/pcm-data , http://www.phoutcomes.info/search/air#page/3/gid/1/pat/6/par/E12000008/ati/102/are/E06000036/iid/30101/age/230/sex/4 , https://indicators.hscic.gov.uk/webview/)

Table 1 was constructed as recommended in Estimating Local Mortality Burdens Associated with Particulate Air Pollution, PHE. The mean anthropogenic PM 2.5 data was taken from the modelled background pollution data supplied by DEFRA from 2014 to coincide with the most recently available mortality data. Mortality data for the local authorities, South East area and England were all taken from the NHS Digital Indicator Portal with the latest available being 2014. The data used was for crude mortality and the associated life years lost was estimated as 12 years per death.

This suggests that the attributable fraction of deaths due to PM2.5 is the same in Wokingham as the national average. PM 2.5 likely does not contribute directly to the number of deaths stated; rather it contributes partially to a much larger number of deaths.

1.1. Trends 2010 to 2015

Figure 2: Comparing the fraction of attributable mortality due to PM 2.5 in Wokingham, the deprivation decile comparator group and England 2010-2015



Source: [Public Health Outcomes Framework (PHOF)]

The data presented demonstrates that fraction of attributable mortality due to PM 2.5 has declined since 2010 in Wokingham, in line with the national picture.

Relative burden of PM 2.5 attributable mortality compared to other causes

Table 2: Mortality rates attributable to major preventable conditions (2015)

Area	Wokingham	South East
Indicator in PHOF	Mortality rate per 100,000	
Preventable mortality (4.03)	**130.5**	**161.2**
Preventable cancers in <75s (4.05ii)	**64**	**73.6**
Preventable CVD in <75s (4.04ii)	**33.7**	**39.4**
Premature mortality attributable to PM 2.5 (3.01)	**11.2**	**11.7**
Preventable respiratory disease in <75s (4.07ii)	**9.8**	**15.2**
Preventable liver disease in <75s (4.06ii)	**9**	**13.1**
Communicable diseases (4.08)	**10.2**	**9.2**
Suicides (4.10)	**6**	**10.2**

Source: Public Health Outcomes Framework (PHOF)

**=suppressed due to small number of cases*

(Please note there is a proportion of overlap between some of the other preventable mortalities and that due to anthropogenic PM 2.5)

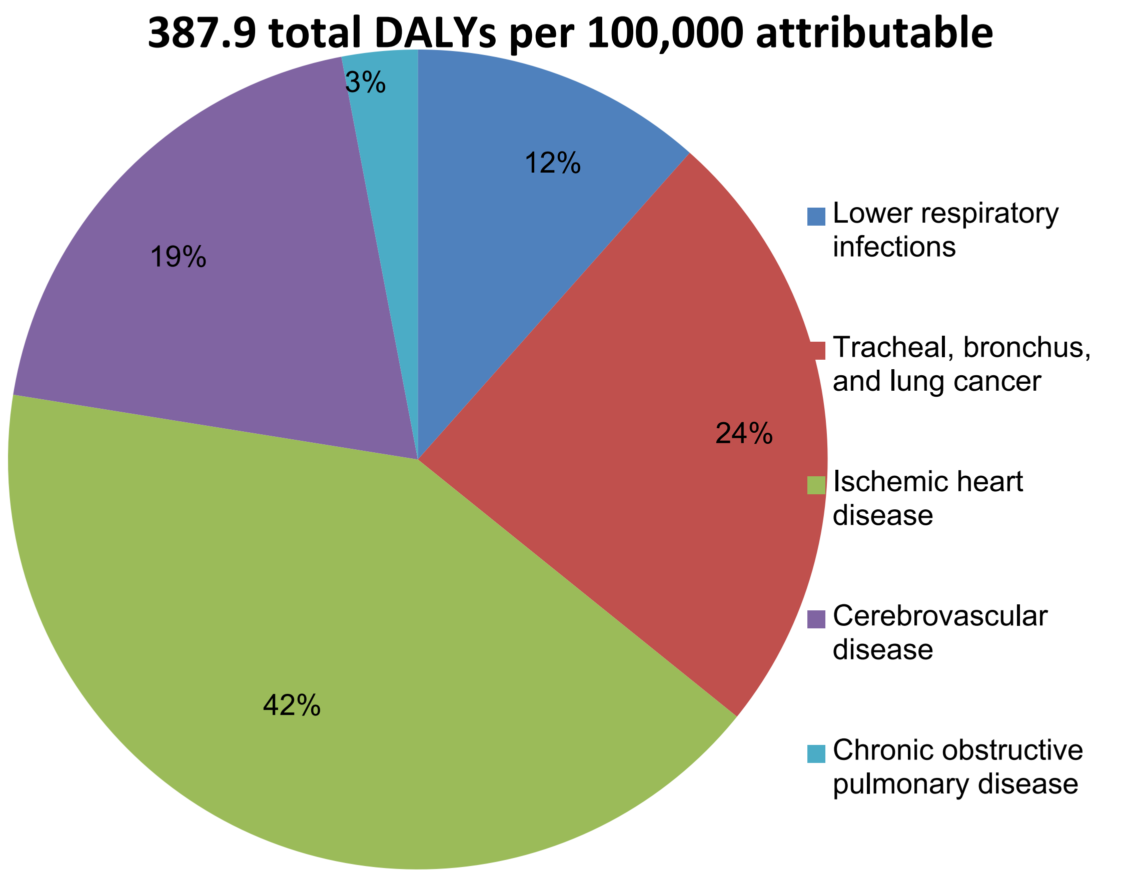
Table 2 shows the premature mortality due to anthropogenic PM 2.5 pollution, in Berkshire local authority areas, when compared to common causes of preventable mortality; such as cancers and cardiovascular disease (CVD). The rate in Wokingham is comparable to that for communicable diseases in those under 75 in Wokingham.

Table 2 was calculated by multiplying supplied attributable mortality rate by the reported premature deaths for each area from PHE. The South East data was taken from PHOF and premature mortality was calculated by averaging the aggregated data for all the South East local authorities.

2. Disability adjusted life years

Disability adjusted life years (DALYs) are commonly used as a measure the overall burden of disease – the measure adds together the years of life lost due to early death, and the years spent living with disability or ill-health. The Global Burden of Disease project has estimated DALYs by age and sex for 306 health conditions with the relative impact of 79 different risk factors, including ambient particulate matter.

Figure 3: Disability adjusted life years per 100,000 population attributable to ambient particulate matter pollution in the South East region, 2013.



Data from Global Burden of Disease Viz Hub

Figure 3 shows the breakdown, as a percentage, the different health issues affected by ambient particulate matter as a percentage of the total 387.9 of DALYs in the South East region.

Lung and respiratory conditions combine to make up 39% of DALYs attributed to ambient particulate air pollution, however the largest single contributor to ill health from exposure to PM is increased risk of ischaemic heart disease (42%), followed by cancers of the lung and respiratory tract (24%), CVD (19%) lower respiratory tract infections (12%) and Chronic obstructive pulmonary disease (3%).

Although the contribution of PM air pollution to total attributable DALYs is relatively low at 2%, of overall attributable DALYs, exposure to PM is responsible for nearly a quarter (22%) of attributable DALYs secondary to lower respiratory tract infections.

Table 3 – Comparison of DALYs for diseases contributed to by ambient particulate matter pollution (2013)

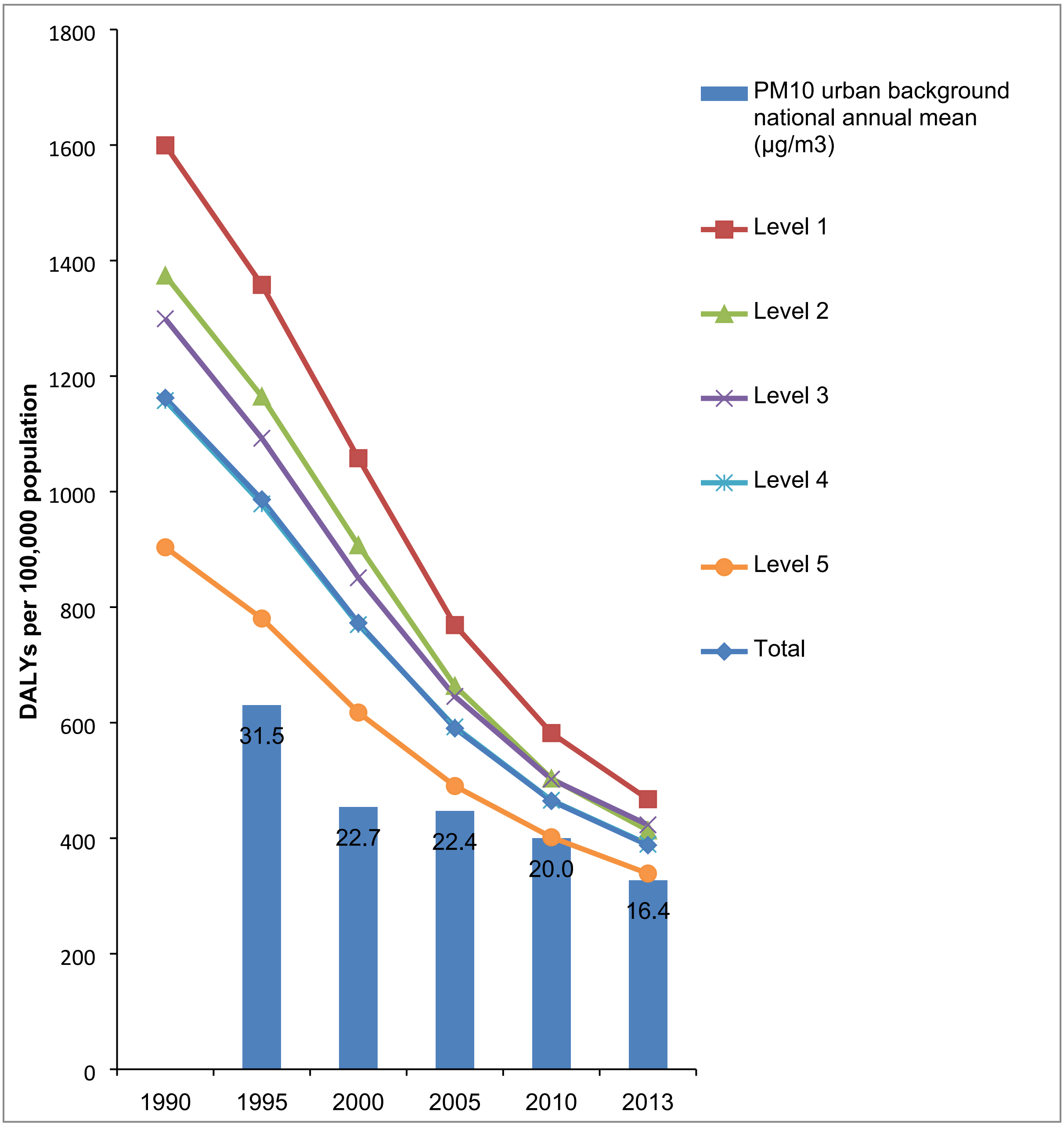
Overall DALYs South East England	Overall	Lower respiratory infections (in those <5)	Tracheal, bronchus, and lung cancer (in those ≥75)	Ischaemic heart disease (in those ≥75)	Cerebrovascular disease (in those ≥75)	Chronic obstructive pulmonary disease (in those ≥75)
Risk factor	DALYs per 100,000					
Smoking	2214.6	94.6	639.9	236.2	118.1	628.0
High body-mass index	2201.1	-	-	474.9	237.0	-
High systolic blood pressure	1766.2	-	-	749.4	424.7	-
High fasting plasma glucose	1343.5	-	-	339.1	117.6	-
Alcohol use	965.2	51.0	-	-73.7	60.8	-
High total cholesterol	818.4	-	-	767.4	51.0	-
Diet low in fruits	589.4	-	100.5	215.7	220.6	-
Drug use	425.4	-	-	-	-	-
Ambient particulate matter pollution	**387.9**	**44.8**	**94.0**	**161.9**	**75.6**	**11.6**
Iron deficiency	276.0	-	-	-	-	-
Occupational exposure to asbestos	230.1	-	168.6	-	-	-
Second-hand smoke	26.5	3.9	4.2	12.2	6.8	-
Percentage of attributable risk due to ambient particulate matter pollution	**2%**	**22%**	**9%**	**3%**	**4%**	**2%**

Data from Global Burden of Disease Viz Hub.

2.1 Burden of disease due to PM and the relationship with deprivation

There are well-documented inequalities in the distribution of pollutants in the UK, although the relationship with deprivation is not straightforward. In general, deprived communities live in poorer-quality environments that experience higher levels of air pollution. Deprivation has also been identified as increasing susceptibility to PM in a number of separate studies. A European review reported that poorer communities were more vulnerable to the effects of PM10 exposure, including morbidity and mortality. Other factors closely associated with deprivation, such as obesity and pre-existing cardiovascular and respiratory diseases, also increase vulnerability. Less access to decent housing, green spaces, jobs and healthy food all contribute to poor health. These stressful conditions may also affect the body's response to air pollution[5].

Figure 4– Change in DALYs attributable to ambient particulate matter pollution in South East England from 1990-2013 by deprivation quintile – PM10 national levels are also displayed to show the relationship



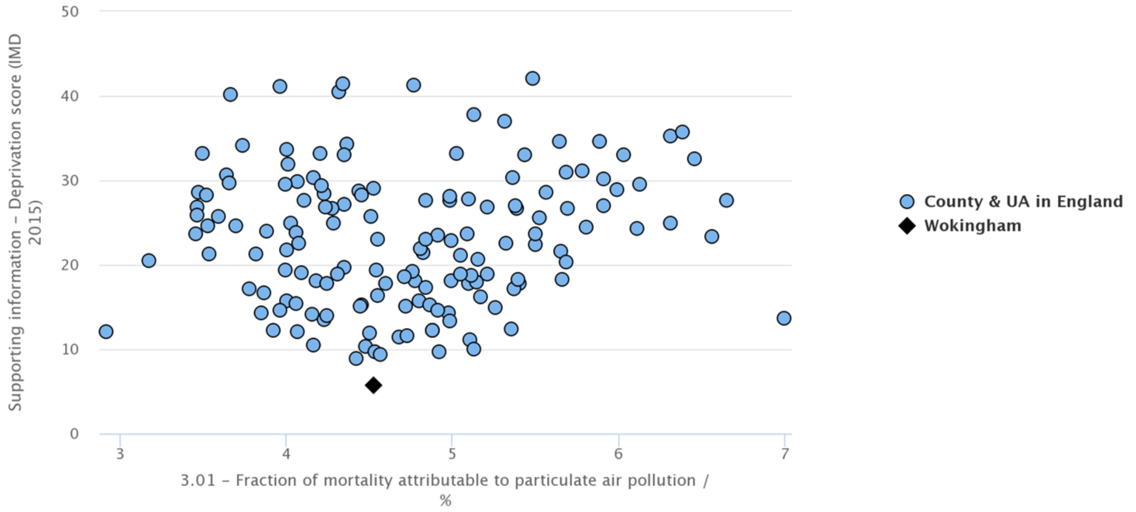
Data from Global Burden of Disease Viz Hub.

Figure 4 shows the change in DALYs attributable to ambient PM pollution from 1990 to 2013, for areas in South East England, according to the deprivation quintile (where 1 is the most deprived and 5 is the least deprived). Average national PM10 data has been included as a useful comparator. There is more historical data available for PM10 than PM2.5

Figure 4 demonstrates that DALYs attributable to PM pollution are higher in more deprived populations and shows a reduction in DALYs is correlated to reductions in PM pollution. Over the past 25 years there has been a significant reduction in morbidity attributable to PM.

This also shows that while national and local efforts to create improvements in air quality are having the desired effect in reducing the morbidity and mortality burden, there were still a significant number of DALYs attributable to ambient particulate matter pollution in 2013. There has historically been a clear relationship between increased deprivation and DALYS attributable to PM air pollution; however the gap between most and least deprived areas has narrowed substantially since 2010. We can also see that DALYs have decreased in line with the national PM10 levels
(Source: https://www.gov.uk/government/statistical-data-sets/env02-air-quality-statistics).

Figure 5- Scatter plot for local authorities showing fraction of mortality attributable to particulate air pollution compared with other LAs in the same deprivation decile



Data from PHOF

Figure 5 is a scatter chart of Wokingham highlighted in comparison to the LAs within the same deprivation decile from 2015.

Figure 5 demonstrates that, using 2015 data, the fraction of mortality attributable to particulate air pollution does not have a comparable relationship with deprivation. This could be due to the increased burden of other diseases in those of higher deprivation and the increased vulnerability to PM 2.5 in more deprived populations.

3.1 Effect of air pollution during pregnancy

Air pollution can affect the foetus during pregnancy, either indirectly through the health of the mother, or directly by affecting developing foetal organs and systems. These effects can have a permanent influence on growth and health throughout life. The evidence of harm due to air pollution to the foetus and the young child is not as strong as it is for adults, because the topic is relatively new and has not been so heavily researched. However systematic reviews have pointed towards PM2.5 exposure leading to low birthweight and pre-term birth[4]. It is likely that maternal air pollution exposure interacts with other stressors in pregnancy such as poor diet, tobacco smoking and exposure to certain drugs. Moreover, the evidence for the effects of air pollution on cardiovascular disease and death in later life is very strong, so it is logical to conclude that reducing exposure to air pollution from as early an age as possible will be beneficial in order to reduce morbidity and early death[3].

4.1 At the local level

The Wokingham LA population is covered by the Wokingham CCG.

6.3% of Wokingham CCG's population have asthma recorded on a GP register (Quality and Outcomes Framework 2015/16). Modelled estimates indicate that 10.8% of under 19s in the CCG have asthma, which is approximately 4,202 children. (Source: Public Health England disease prevalence models; Modelled on NHS Digital (2016) registered population figures)

In 2013/14, Wokingham CCG had 28 emergency admissions for asthma in under 19 year olds. This was a rate of 78 per 100,000 population, which was one of the lowest rates in the country (6th out of 221 CCGs).

1.0% of Wokingham CCG's population have COPD recorded on a GP register, although 2.4% are estimated to have the condition (QOF 2015/16). Modelled estimates indicate that 0.42% of under 19s in the CCG have COPD, which is approximately 164 children.

In 2012/13 there were 135 admissions for COPD in Wokingham CCG, a rate of 0.87 per 1000 population, lower than the England rate of 2.15 (Source: PHE Inhale profiles)

In 2012/13 there were 95 admissions for asthma in Wokingham CCG, a rate of 0.61 per 1000 population, lower than the England rate of 1.21 (Source: PHE Inhale profiles)

In 2014/15, there were 484 admissions for coronary heart disease in Wokingham CCG. This was a rate of 335 per 100,000 population, which was significantly lower than both the comparator group and national rates. (Source: Public Health England (2016); Cardiovascular Disease Profiles)

In 2014/15, there were 213 admissions for stroke in Wokingham CCG. This was a rate of 153 per 100,000 population, which was similar to the comparator group and significantly lower than the national rate. (Source: Public Health England (2016); Cardiovascular Disease Profiles)

In 2015, 22 people aged under 75 died from a respiratory disease in Wokingham CCG, which is a rate of 15 per 100,000 population. (Source: NHS Digital (2016))

National & Local Strategies (Current best practices)

International co-operation

In 1979, 32 countries in the pan-European region signed the UNECE Convention on Long-range Transboundary Air Pollution, creating the first international treaty to deal with air pollution on a broad regional basis. The Convention entered into force in 1983, laying down the general principles of international cooperation for air pollution abatement.

The Convention has substantially contributed to the development of international environmental law and has created the essential framework for controlling and reducing the damage to human health and the environment caused by transboundary air pollution. (http://www.unece.org/environmental-policy/conventions/envlrtapwelcome/the-air-convention-and-its-protocols/the-convention-and-its-achievements.html)

EU Air Quality Directive

This sets out air quality standards and requires all Member States to undertake air quality assessment, and to report the findings to the European Commission on an annual basis. The UK has statutory monitoring networks in place to meet the requirements of these directives, with air quality modelling used to supplement the monitored data. (http://ec.europa.eu/environment/air/quality/legislation/directive.htm)

National Air Quality Strategy

The air quality strategy for England, Scotland, Wales and Northern Ireland was published in 2011 and set out air quality objectives and policy options to further improve air quality in the UK.
(https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69336/pb12654-air-quality-strategy-vol1-070712.pdf)

National monitoring

Nationally, DEFRA monitors levels of a number of pollutants using the Automatic Urban and Rural Network (AURN). It includes automatic air quality monitoring stations measuring oxides of nitrogen (NOx), sulphur dioxide (SO2), ozone (O3) and particles (PM10 and PM2.5) which provide high resolution hourly information. This information is available publically - https://uk-air.defra.gov.uk/interactive-map

Air Quality Management Areas (AQMA)

Since December 1997 each local authority in the UK has been carrying out a review and assessment of air quality in their area. This involves measuring air pollution and trying to predict how it will change in the next few years in order to make sure that the national air quality objectives (link in ‘See Also’ section) will be achieved. These objectives have been put in place to protect people's health and the environment.

If a local authority finds any places where the objectives are not likely to be achieved, it must declare an Air Quality Management Area (AQMA) there. This area could be just one or two streets, or it could be much larger.

Then the local authority will put together a plan to improve the air quality - a Local Air Quality Action Plan.

In Wokingham there are 4 AQMAs which are summarised below with links to their page on the DEFRA website:

Wokingham

AQMA	Date Declared	Pollutants
Twford crossroads	09/12/2015	Nitrogen dioxide NO_2
Wokingham Town Centre	09/12/2015	Nitrogen dioxide NO_2
Wokingham AQMA	07/05/2004	Nitrogen dioxide NO_2

No Air Quality Action Plan is available for download currently. Please contact Wokingham Borough Council for further information.

Note that AQAP for both areas is in development in Wokingham - a workshop was held in February 2017.

What is this telling us?

The national and local evidence suggests that whilst air pollution levels have improved over the last couple of decades there is still a significant health burden from the current levels of pollutants.
Wokingham has a similar percentage of PM2.5 attributable deaths to the regional and national average. When compared to the comparator group of LAs in the same deprivation decile, Wokingham has results in line with the rest of the group.
The national and local data shows that areas of higher social deprivation also suffer with a higher attributable mortality and DALYs in comparison to those LAs with less social deprivation. This demonstrates that more deprived areas have a higher burden of disease in relation to PM pollution.

What are the key inequalities?

Air pollution is harmful to everyone; however it does affect some groups more:

Disability and long-term conditions - DEFRA guidance also advises that children, adults and older people with existing medical conditions such as cardiovascular or respiratory conditions, including asthma will also be vulnerable to poor air quality.

Age - Air pollution affects children more than adults because children tend to spend more time outdoors and because their lungs are still developing. Air pollution also affects older people more due to age-related loss of antioxidant defence mechanisms in the lung and elsewhere, because they are more likely to have developed chronic cardiorespiratory diseases (The Royal College of Physicians Every Breath We Take report (2016))

Maternity - Some pollutants, when inhaled by the mother, can cross through the placenta to the developing baby.

Deprivation - Those who live in deprived areas; which often have higher levels of air pollution and also increased vulnerability to the effects of pollutants.

<u>What are the unmet needs/service gaps?</u>

Continuous monitoring and compliance with EU and national requirements for reducing air pollution are still needed to ensure the long term downward trend in air pollution continues.

Increasing public awareness of the benefits of good air quality is a priority as if they are aware of the risks of air pollution and the potential benefits they may be inclined to participate in or support actions at the local level.

<u>Recommendations for consideration:</u>

Public health

- Improve the local population's knowledge of the impact of air pollution on health and to raise understanding that improving air quality would help to improve healthy life expectancy and reduce early death from cardio-respiratory diseases
- Tailor messages to target those members of the public particularly susceptible to air pollution such as those with asthma and chronic obstructive pulmonary disease (COPD)
- Work with others to promote initiatives to facilitate active travel (for example Healthy Schools Programmes, school travel plans; cycle to work schemes etc)
- Promote knowledge of ways to mitigate your own exposure, for example avoiding rush hour or travelling along a less polluted route.
- Raise awareness of the need to improve air quality through linking to other public health issues such as obesity and through working with Health and Wellbeing Boards to include air quality in Joint Strategic Needs Assessments and Health and Wellbeing Strategies

Local authorities

- Encourage schemes that recognise excellent levels of environmental and energy saving performance for the vehicles that operate within their area
- Introduce intelligent transport systems that maximise the efficiency of the highway network and also give real time information on traffic delays and journey times, car parking availability, and bus arrival times; together, these allow people to make better informed travel choices and also reduce traffic emissions
- Encouraging the use of vehicles with 'cleaner' fuels such as petrol or LNG rather than diesel.
- Installing electric vehicle charging points.
- Incorporate air quality into planning considerations for new developments and refurbishments
- Promote energy efficiency and sustainable transport to residents and businesses in the borough and putting in the necessary infrastructure (for example electric car charging points) to enable people to reduce the emissions they produce.

- Consider if a “clean air zone” would be an appropriate intervention in their area - https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/486636/aq-plan-2015-overview-document.pdf

See also

AQMAs - https://uk-air.defra.gov.uk/aqma/

National air quality objectives - https://uk-air.defra.gov.uk/assets/documents/National_air_quality_objectives.pdf

EU air quality limit values - http://ec.europa.eu/environment/air/quality/standards.htm

Local air quality management guidance - https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69334/pb13081-tech-guidance-laqm-tg-09-090218.pdf

Air quality alerts - https://twitter.com/DefraUKAir

DEFRA air quality data - https://uk-air.defra.gov.uk/

Annual DEFRA report - https://uk-air.defra.gov.uk/library/annualreport/viewonline?year=2015_issue_1

National emissions statistics - https://www.gov.uk/government/statistics/emissions-of-air-pollutants

Royal College of Physicians Summary of the health effects of air pollution – https://www.rcplondon.ac.uk/projects/outputs/every-breath-we-take-lifelong-impact-air-pollution

Health effects of Ozone - https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/492949/COMEAP_Ozone_Report_2015__rev1_.pdf

DEFRA NO2 Action Plan - www.gov.uk/government/collections/air-quality-plan-for-nitrogen-dioxide-no2-in-uk-2015

Lancet systematic review comparing ambient air pollution to mode of transport - http://www.sciencedirect.com/science/article/pii/S2468266716300214

DEFRA Air Quality briefing for Public Health Directors - https://laqm.defra.gov.uk/assets/63091defraairqualityguide9web.pdf

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7. Public Health Outcomes Framework. Public Health England (http://www.phoutcomes.info/)

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