Lung & Asthma Information Agency

Trends in outdoor air pollution in the UK

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Introduction

Advice on air quality and on the health effects of air pollution on vulnerable individuals such as those with asthma is now routinely issued when high levels of air pollution are anticipated. Increased media coverage reflects both public concern about air pollution and the growing body of research showing adverse health effects of exposure to a range of pollutants. Experimental and population studies have shown that nitrogen dioxide, ozone, sulphur dioxide and airborne particulates may have acute adverse effects on the respiratory system, at levels at or near to levels observed during air pollution episodes in the UK. Exposure to high levels of these pollutants over short periods, ie hours or days, is generally considered more hazardous than longer-term low level exposure over weeks or months and this is reflected in the WHO air quality guidelines and the air quality bands used by the Department of the Environment (Figure 1).

Figure 1: DOE air quality bands and WHO air quality guidelines

	DOE air quality bands Maximum 1 hr average		WHO guidelines 1 hr average	WHO guidelines 24 hr average
	Poor	Very poor		
NO_2 (ppb)	100-299	≥300	210	80
SO_2 (ppb)	125-399	≥400	122	-
Black smoke ($\mu g/m^3$)	-	-	-	125
Ozone (ppb)	90-179	≥180	76-100	50-60 (8 hour average)

Trends in emissions

Changes in emissions have an affect on air quality, although other factors are also important.

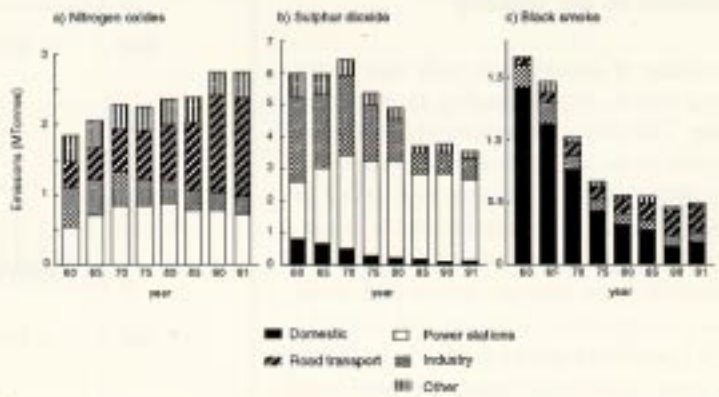
Nitrogen dioxide

Power stations burning fossil fuels and motor transport are the two main sources of nitrogen oxides (NO_x). Nitric oxide (NO) - the main constituent of these emissions - reacts with oxidising agents in the atmosphere to form nitrogen dioxide (NO_2). Emissions of NO_x (figure 2a) have increased over the last 30 years, mainly as a result of increases in road transport. The introduction of three-way catalysts to new vehicles will reduce future emissions from this major source.

Sulphur dioxide and black smoke

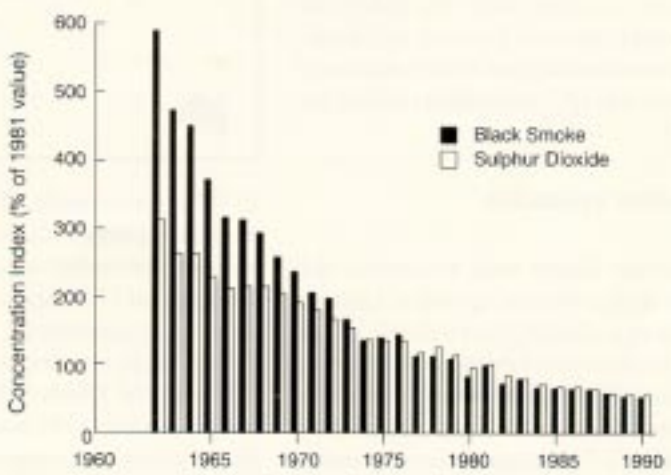
Sulphur dioxide (SO_2) is created by the burning of fossil fuels containing sulphur. Nationally, power stations are now the main source of emissions although coal burning remains a significant source in some local areas. Emission levels are declining (figure 2b) and this trend is expected to continue. Black smoke consists of small particles produced by incomplete combustion. Diesel vehicles are now the main source in urban areas following the decline of coal burning.

Figure 2: UK trends in emissions of nitrogen oxides, sulphur dioxide and black smoke



Source: WSL, National Atmospheric Emissions Inventory

Figure 3: Average urban concentrations of smoke and sulphur dioxide in the UK



Source: Warren Spring Laboratory

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Emissions have dropped dramatically in recent years (figure 2c) although emissions from diesel vehicles are increasing.

Ozone

Ground level ozone is a so-called secondary pollutant. It is formed by a complex photochemical reaction involving the action of sunlight on oxygen and NO_2, catalysed by volatile organic compounds. Ozone production is dependent on weather conditions and may occur considerable distances from the source of precursor substances. There are no significant direct sources of emission in the UK.

Trends in air quality

In the UK as a whole, trends in annual average levels of SO_2 and black smoke over the last few decades reflect the downward trends in emission levels (figure 3). Underlying trends in levels of NO_2 and ozone are less easy to determine. There are some indications of a general rise in NO_2 levels, although levels in city centres have not necessarily risen. Average background levels of both NO_2 and ozone in central London, for example, show a modest downward trend (figure 4).

Variations in air quality

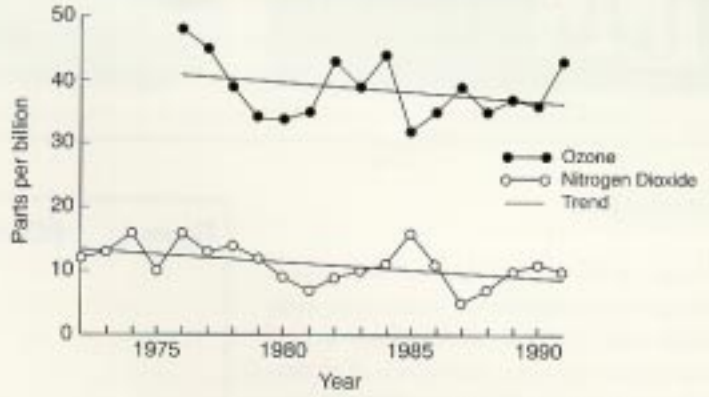
The volume of emissions is only one factor affecting day to day air quality at any given location. The siting, proximity and height of emission sources, weather conditions and other factors affecting the direction and speed of dispersion are also important. As a consequence, daily pollution levels often deviate substantially from average values and levels also vary geographically. In general, levels of NO_2, SO_2 and black smoke tend to be higher in urban areas, while ozone concentrations tend to be higher in rural areas. Roadside levels of some pollutants may exceed levels recorded at background urban monitoring sites.

An individual's personal exposure and the dose received by the lungs will also depend on many factors including where the individual lives and works, exercise patterns, and exposure to cigarette smoke and indoor sources of pollution (such as NO_2 emitted by unflued gas appliances).

Air pollution episodes

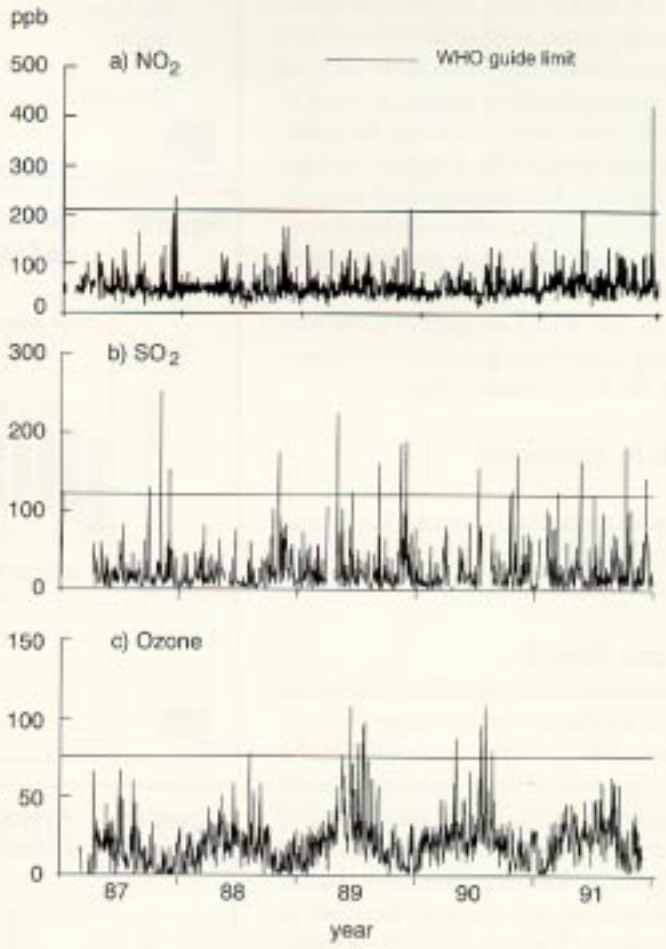
Annual average figures tend to conceal the occurrence of air pollution "episodes" (periods when levels of pollution rise markedly above average) which may be of greater concern from a health point of view. The pattern of episodes at one urban site (central London) is illustrated in figure 5. The occurrence and pattern of episodes varies in different locations.

Figure 4: Trends in annual average concentrations of ozone and nitrogen dioxide in central London



Source: Warren Spring Laboratory

Figure 5: Daily maximum hourly levels of NO_2, SO_2 and ozone in central London



Source: Warren Spring Laboratory

In 1991, for example, WHO one hour guide values for NO_2 were exceeded at monitoring sites in London, Sheffield, Glasgow, and Manchester; SO_2 guidelines were exceeded at monitoring sites in Belfast (where WHO guide levels were exceeded on 37 days) and in South and West Yorkshire, Hertfordshire, Staffordshire, Nottinghamshire and central London; and ozone guidelines were exceeded at monitoring sites in the South West and South East, Oxfordshire, Cumbria and North Ireland. Black smoke guide levels were also exceeded at various sites in 1991 but excess concentrations of both SO_2 and black smoke (pollutants which are considered more hazardous in combination) occurred only in Belfast.

We are grateful to Warren Spring Laboratory for advice and the provision of data from WSL monitoring sites and the DOE national network. Daily information on current air quality, and health advice when it becomes poor, are available on free phone 0800 556677; CEEFAX page 404; and TELETEXT page 187.