

## THE EFFECTS OF NITROGEN DIOXIDE ON HUMAN HEALTH

Extract from Department of the Environment (1996), Expert Panel on Air Quality Standards – Nitrogen Dioxide. London: The Stationery Office.

18. People with healthy lungs, whether at rest or exercising, show little response to experimental inhalation of nitrogen dioxide at concentrations well above those occurring in the ambient air, even during extreme pollution episodes. Very small changes in sensitive tests of lung function have been recorded at exposures between 2500 and 7500 ppb. However, in people with asthma, some studies have shown changes in these tests of lung function to have occurred at exposures of around 300 ppb when the subjects have been exercising, though other studies have shown no changes at higher concentrations. Measurements of the responsiveness of the lung to inhalation of irritant chemicals have shown that the airways of some people with asthma may become more sensitive to such stimuli after exposure to nitrogen dioxide at concentrations down to about 200 ppb. It should be noted that this concentration is only reached in occasional episodes of outdoor air pollution in the United Kingdom. In 1976, an early study reported similar effects in people with asthma at concentrations as low as 100 ppb. However, these findings have never been repeated in any other study, and the Panel considered that there was sufficient doubt about the validity of the measurements of nitrogen dioxide for this isolated result to be disregarded.

19. Other studies have investigated the possibility that inhalation of nitrogen dioxide at moderate concentrations may cause an inflammatory reaction in the lungs or may increase the susceptibility of individuals to subsequent inhalation of allergens, such as those from house dust mite or grass pollen. The inflammatory reaction, if repeated frequently, might act to decrease the resistance of individuals to infection, and is more relevant to repeated exposures to elevated indoor levels than to exposure to the outdoor concentrations typically occurring in the United Kingdom. At present, the evidence from both human and animal studies is equivocal. However, there is some evidence that exposure to nitrogen dioxide can enhance the response of someone with asthma to inhalation of allergen. After exposure of volunteers with asthma to 400 ppb for one hour, inhalation of dust mite extract has been shown to cause a significantly greater fall in lung function than occurred in a control experiment, suggesting that the gas may have primed the airways to react more readily to the allergen. A similar finding has been reported following ozone exposure and grass pollen inhalation and it may be that this subtle effect is a more important consequence of irritant gas exposure than the more direct effects on lung function. Nevertheless, to date all these effects have only been demonstrated at concentrations of nitrogen dioxide that occur in the ambient air of the United Kingdom only in the most exceptional circumstances.

24. Since exposure to nitrogen dioxide indoors is often an important contributor to the overall exposure of individuals, some studies have specifically investigated relationships between such exposure and health. Indoor concentrations of nitrogen dioxide in the kitchens of homes with gas cookers average, over a year, around 15 ppb and peak concentrations may be as high as almost 600 ppb over an hour. The outdoor concentration of nitrogen dioxide is the main determinant of indoor concentrations in homes without gas cookers, the concentrations generally being somewhat lower indoors. In homes with such cookers, indoor levels are usually at or above outdoor levels, being higher in the winter months when homes are less well ventilated and more use is made of gas appliances. Thus people living in homes with gas cookers are exposed to more nitrogen dioxide indoors than those living in other homes. Studies of children living in homes with gas cookers have led to suggestions that the increased symptoms reported in these children may be due to their increased exposure to nitrogen dioxide from this source. There are fewer studies of the association between lung health and gas cooking in adults and the associations reported have not been consistent, but a recent study in East Anglia showed that young women who had gas cookers had substantially more respiratory symptoms and poorer lung function on average than women from homes with electric cookers. Although these effects could be due to nitrogen dioxide, it should be borne in mind that gas cooking has much wider effects on the indoor environment and that these may also affect respiratory health. Taking all this evidence into account, the Panel have taken the view that a long-term effect of chronic exposure to nitrogen dioxide, whilst not yet demonstrated, cannot be ruled out.