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"Breathe Clean Air": the role of physicians and healthcare professionals

Summary

The health effects of air pollution have a lot in common with those related to active or passive smoking. However, environmental problems pose a rather different set of challenges to physicians and other healthcare professionals.
Four target levels of action may result in a reduction of the health impact of air pollution. The first two levels act on the environment rather than the individual: 1) abatement of ambient air pollution at the source to improve ambient air quality; and 2) reduction of pollution in the indoor environments where people spend most of their time. The other two downstream strategies depend entirely on the individual: 3) individual action to reduce personal exposure or dose; and 4) treatments taken to modify personal responses to air pollution, and/or to strengthen defence mechanisms.

Statement of Interest
None declared.

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Abatement of ambient air pollution

Sustained improvement of air quality through the reduction of emissions is the most important strategy. Stringent air-quality regulations are needed to improve air quality. The role of healthcare professionals is the same as that of any informed citizen: to call for and support air-quality regulations. The opinions of healthcare professionals on health-related issues can be influential in the decision-making process. To publicly defend the scientific evidence, which calls unambiguously for better air quality in large areas of Europe and the world, is thus a very relevant role for physicians and other health authorities.

Reducing indoor pollution of outdoor origin

People spend most of their time indoors. The most prevalent problem for indoor air quality is still environmental tobacco smoke, and other indoor sources, such as fireplaces, kerosene heaters and consumer products (or, in certain regions, radon from underground), may influence air quality in the home more than outdoor air pollutants. In the absence of indoor pollution sources, however, indoor levels of "outdoor" pollutants are strongly dependent on outdoor air quality. People may have some, albeit limited, means to reduce the impact of outdoor pollution on indoor air quality. Concentrations of highly reactive gases, such as ozone, are far lower indoors with ultrafine particles from fresh exhaust tending to accumulate over time and with proximity to sources. So, measures such as opening windows only outside rush-hour times and hours with high ozone levels may help to minimise indoor air pollution.

Concentrations of several ambient air pollutants are lower in air-conditioned rooms such as modern offices and public indoor spaces. On the other hand, air conditioning uses a lot of energy, and thereby may add to outdoor pollution levels, depending on the type of power generation. A contentious question is whether patients, in particular those with respiratory diseases, should invest in indoor air filter systems. While air cleaners with high-efficiency particulate air (HEPA) filters do indeed reduce particulate matter concentrations in experimental indoor settings, very few studies have confirmed that the use of such HEPA filters improves health under real-life conditions. While the possible benefits should not be dismissed, such solutions must be weighed against costs, energy consumption, nuisance caused by the device and the relative importance of exposure during time spent in all other places. People should be discouraged from buying "air cleaners" that produce ozone or other gases known to have adverse health effects.

Modifying personal exposure or dose

Air pollution will remain a reality for many years to come, so adverse health effects will be inevitable. In light of this fact, people might be interested in pursuing personal strategies to reduce their exposure or dose, in spite of poor air quality. Personal exposure and dose depend on location and time–activity patterns.

Location matters

People living within 50–100 m of a busy road face much higher exposure to traffic-related pollutants. Health risks ultimately depend on distance to the road, traffic density and type (*e.g.* stop-and-go, uphill/downhill, diesel trucks/buses), as well as urban structure and wind direction. Concentrations of primary traffic-related pollutants dilute to background levels within only a few dozen to hundreds of metres. They are also lower in the upper levels of multi-storey buildings than on the ground floor.

Patients as well as young families may have options to make healthier choices if they have access to appropriate advice. While individuals cannot influence ambient levels of pollutants directly, and moving may not be possible, they may have options about where to spend their time.

Walking along roads where traffic flow is heavy results in far higher exposure than using an adjacent street with low or no traffic (*e.g.* a pedestrian zone). Given the known health effects (see box on the next page), jogging along highways and busy roads should be discouraged and alternative routes with lower levels of pollution should be chosen instead. Consequently, day-care institutions, schools and sports grounds should not be placed next to busy roads.

Time and activity matters

Ambient concentrations of many air pollutants have typical diurnal patterns, *e.g.* with higher pollution during rush hours, or peaks in oxidants (summer smog) in the afternoon and early evening. The dose of pollutants reaching the target organs increases with physical activity. Therefore, choices about time and activity levels ultimately affect exposure and dose. What constitutes a "high-pollution period" in one area may be considered normal in other, more polluted, cities. Therefore, it is not possible to give recommendations for limiting activity at distinct pollutants concentrations. Generally,

Living close to traffic: a health concern

A large proportion of the European population lives in apartments or houses built alongside busy streets. Exhaust pollutants, such as ultrafine particles, carbon monoxide or other primary gases, reach very high concentrations along streets; with the most extreme conditions found in narrow streets lined with tall buildings. Due to dispersion and aggregation, concentrations of these pollutants rapidly decrease to urban background levels within only 50–100 m of main traffic arteries. Diesel cars, trucks and buses emit particularly high concentrations of soot and large numbers of very toxic substances are loaded on these fine particles; toxic substances are also found in the coarse particles formed from brake wear and road surface abrasion and these particles are re-suspended in the air by moving traffic. As a result, exposure to these pollutants can be very high during busy commuting periods, and among people walking, playing or living close to main streets.

Many newer epidemiological studies are investigating or have investigated health outcomes as a function of proximity to traffic. With potential confounding factors taken into account, these studies suggest strongly that living close to a busy road poses a risk to health due to pollution. However, these studies are also very heterogeneous in their methodology, and a recent critical review called for more targeted research, since the current evidence for a range of outcomes is suggestive but not conclusive [1]. The development of asthma in children is an exception: large amounts of data are available. With a publication from the Californian Children's Health Study, the evidence has become strong that traffic-related pollutants contribute to the development of childhood asthma, at least among children who are genetically susceptible [2]. This evidence raises new challenges for policy-makers as urban planning decisions may have major public health implications. The findings may also initiate debates in school boards and communities about the location of schools and daycare facilities in immediate vicinity of major traffic arteries.

in periods of summer smog, outdoor activities requiring endurance (distance events, soccer, *etc.*) should be shifted to morning hours. At times of very high particulate pollution, schools may choose to organise their sporting events in indoor arenas rather than outdoors.

Under conditions of extreme air pollution, people may opt to wear masks. Masks cannot provide full protection against exposure to ambient air pollutants. Particulate matter exposure, in particular the fine and coarse fractions as well as the dust, can be reduced to some extent. However, the long-term health benefits of wearing masks has not been investigated. It is known from investigations of occupational exposure that the fit of a mask is much more important than the type of filter [3].

Clinical action and preventive treatment: the roles of physicians

Clinical role

The clinical problems caused by air pollutants are not specific and, therefore, stringent diagnostic proof that a patient suffers from a problem related to ambient air pollution is most probably impossible. The treatment and counselling of patients suffering from health problems "possibly related to air pollution" is no different from dealing with these health issues when they have other causes. The risks of exacerbations of chronic diseases, such as asthma or chronic obstructive pulmonary disease, as well as cardiovascular problems increase during periods of higher pollution. Patients may be advised to comply with preventive treatments during such periods. In some cities, monitoring data and/or short-term prognosis of air-pollution concentrations are readily available and may guide susceptible patients.

Preventive role

Counselling

Patients may know about air pollution-related health effects and/or may confront physicians with their opinions, beliefs and fears about air pollution. Clinicians need to put air pollution

into the rational and broader context of a patient's life and personal situation. The comparison of this environmental risk with other health-relevant factors the patient may be exposed to is relevant here. First and foremost, physicians should explain to smokers that the risk related to air pollution is incomparably smaller than the one due to the smoking habit; and it is far easier and more effective to change the latter. Parents who smoke must understand that passive exposure of children to smoke poses a health risk of similar magnitude to that posed by ambient air pollution.

Preventive interventions

Should doctors treat patients to protect them against the adverse effects of air pollution? The literature on the interaction of air pollutants with preventive treatments is limited.

Antioxidants and vitamins

Many ambient air pollutants are very strong oxidants. Moreover, endogenous oxidative stress is a consequence of effects mediated by the effects of ambient air pollution. It is therefore plausible to expect that antioxidants could have a role in defending against the effects of air pollution. There have been very few controlled studies in this area. Two have been conducted, in Mexico and the Netherlands, looking at the modifying role of antioxidant vitamin supplements on the respiratory effects of air pollution in children (fig. 1). It is uncertain whether the findings can be extrapolated to other areas of the world, other health outcomes and other age-groups.

The role of a healthy diet, with fruit and vegetables rich in antioxidants, is acknowledged in the prevention of various diseases in general. As a "no-regret" strategy, it is therefore appropriate to inform patients about a possible protective role of antioxidants against at least some of the health effects related to air pollution.

Asthma treatments

The responses of asthmatics to air pollutants are not specific and therefore treatment against the effects of air pollution is the same as treatment for asthma in general. Clinical studies have shown that leukotriene receptor antagonists and salmeterol decrease pollutant-induced bronchoconstriction in asthmatics. Corticosteroids may attenuate inflammatory response to ozone, but they do not influence pollutant-induced lung function decrease. New research is focusing on the induction of enzymatic antioxidant defences, especially for individuals with increased-risk genetic variants of key antioxidant enzymes [2]. The evidence from panel studies on asthmatics investigating symptoms or lung function effects related to pollutants is not consistent. Some studies observed fewer distinct pollutant effects in asthmatics on anti-inflammatory therapy, possibly due to a protective effect of this medication. Others found a stronger effect, possibly due to the fact that the group of asthmatics using anti-inflammatory therapy consists of the more severe cases.

Statins

Statins have anti-inflammatory properties. Interactions of these drugs with the inflammatory effects of air pollution are conceivable but have rarely been investigated. Therefore, to prescribe statins in an attempt to abate effects of air pollution would be an entirely inappropriate interpretation of the current evidence.

Genetic counselling

Genetic make-up is also a determinant of a subject's susceptibility to the effects of ambient air pollution. A range of biological pathways underlies the mechanisms linked with the effects of ambient air pollution. Thus, functional variants of genes along these pathways might also affect the biological effects of air pollution. So far, the literature on this gene–environment interaction is very slim and potentially affected by a publication bias favouring positive findings. A stream of such studies is expected to be published in the future. While these results will be of high scientific interest, they cannot give guidance to physicians on how to advise patients. In addition, there are inherent limitations of gene-based counselling for preventive measures regarding environmental health effects.

Inherent limitations of preventive treatment

The contribution of drugs, vitamins or single genetic variants to the amplification or reduction of the effects of air pollution is uncertain but it is not expected to be large. In contrast to strategies that tackle the environmental problem and exposure *per se*, preventive action at the individual level will remain limited, costly and ultimately inefficient.

Summary

In summary, the focus of prevention must be on improving ambient air quality. All other actions are less efficient and unsustainable, and shift the burden of action from causes to individuals. Individual strategies are more likely to target acute effects only, so long-term effects may occur regardless. The individual approach raises problems of compliance and applicability. It further amplifies environmental injustice, in that the socially deprived have far less opportunity to adopt personal preventive strategies.

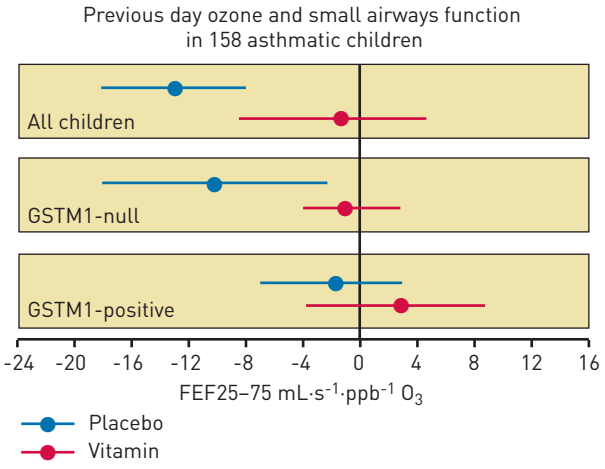

Figure 1
The association between small airway function, indicated by FEF25–75, and ambient ozone concentrations (previous day) in 158 asthmatic children participating in an 18-month controlled intervention study. Associations were particularly strong among those not taking antioxidant supplementation. Moreover, the effects of ozone were much stronger too among those with a non-functional variant in the GSTM gene – relevant in oxidative defence mechanisms. Data from [4, 5].

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