IN-DEPTH REVIEWS

Environmental health: overview

Jon Ayres

The range and pattern of environments in which we lead our respective lives is unique to each of us. While there are many common components to these differing environmental patterns at a broader level—we all spend differing amounts of time at home, at work and travelling—the quality, duration and intensity of individual exposures will vary substantially among individuals. It has been this complexity that to some extent has delayed our understanding of the effects of exposures in the non-occupational environment, but time and science have progressed such that we are now in a better position to understand these complexities and thus deal with the effects of these exposures. The aim of this series of articles on environment and health is to highlight some of the issues in determining health effects arising from wider (i.e. non-occupational) environmental exposures and to explore the way that these exposure–effect relationships can now be approached with a greater degree of confidence than was possible in the past. They will also explore some of the basic underlying concepts of environmental medicine and health, many of which will be recognizable to those working in the occupational field.

In an occupational setting, the cause of a work-related disease is usually evident. Control of the exposure should remove, or at least reduce, any health effect resulting from that exposure, thus improving the health not just of the identified individual but the rest of the workforce. The exposure is usually simple (e.g. coal dust) and the route of exposure usually single (e.g. inhalation). Targeting specific control measures is, therefore, straightforward, at least in theory. Environmental exposures, on the other hand, are more likely to be complex or multiple (e.g. air pollution) and the routes of exposure may also be multiple (e.g. pesticides).

But the framework of exposure → effects → control (Figure 1) forms the basis for both apparently simple and potentially complex exposures—a framework which not only guides management strategies but also identifies research areas. The four articles in this series address the issue of assessing exposures in general, problems of relating exposures from point sources to real or perceived health effects, where indoor air fits in when considering outdoor air exposures and, lastly, explores one apparent oddity from the air pollution field—the effect of polluted air on individuals with heart disease.

In the first of these articles, Semple [1] explores the difficulties in assessing environmental exposures and how these approaches have sprung from the occupational hygiene field. As environmental exposures often occur by multiple routes, direct measurements may be impossible but knowledge of potential routes and proportional contribution allows modelling to be developed to estimate exposures. If that exposure can be reliably estimated by a specific biomarker (e.g. blood lead) so much the better, but we have relatively few such biomarkers. Nevertheless, recent advances in modelling allows us to begin to make inroads into the complexity of exposure estimation with diffuse multiple environmental exposures.

When an environmental exposure has been thought to be responsible in some way for an adverse effect on health, the responsibility for management and investigation of the situation often falls to public health physicians, often fuelled by concerns expressed by the public. Good examples are point sources of pollution (e.g. incinerators, landfill sites) and perceived ill health in the nearby population. In the second of these four articles, Kibble and Harrison [2] explain the issues surrounding measurements of emissions from point sources, estimation of resulting exposures and the problems associated with determining whether these exposures give rise to health effects. The same principles apply to health impact assessment (HIA) that should be undertaken under the umbrella of environmental impact assessment in relation to planned new industrial sites, such as landfills. The fact that HIA is generally extremely poorly undertaken in the UK (if done at all!) is partly because there is relatively little guidance as to how this should be undertaken.

Outdoor air pollution is now generally accepted to be a cause of significant exacerbation of disease on a day-to-day basis. The effect sizes appear to be small at a total population level and the exposures are very much lower than is the case in workplaces. This initially resulted in some believing that this was an indication of poor
methodology by air pollution scientists and that the results were spurious. Subsequently, this has been shown not to be the case and the huge body of evidence from many sites across the world consistently provides the same findings. But we spend 90% of our time indoors, so how important are indoor exposures compared with those outside? Myers and Maynard [3] explore these issues and raise the question as to whether the time is right for indoor air quality standards such as we have for outdoor air and for indoor occupational exposures.

Once the outdoor air pollution effects were accepted as real, it became clear that some of the effects were, surprisingly, being seen in individuals with heart disease. While it is intuitively logical that breathing polluted air might affect people with pre-existing lung disease, why so for those with cardiac disease? In the fourth article of the series, Routledge and Ayres [4] describe the story of the cardiovascular effects of air pollution which has forced those exploring mechanisms to reconsider the conventional toxicological approach of ‘if high mass concentrations of exposure cause no harm then we needn’t worry about low mass concentrations’.

As we better understand environmental exposures, we are better able to predict and measure any resultant health effects. New ideas in how to estimate exposures, new approaches to identifying health impacts, and challenging conventional mechanistic processes, not only means we can identify important exposures and their outcomes and thus ways of controlling exposures, but also raises issues about how we identify and deal with the effects of multiple co-exposures. These complex issues require a true multi-disciplinary approach and the skills of the occupational health and hygiene communities will be a key to helping to develop an appropriate methodology in managing exposures in the wider environment.

References