

The background features a series of concentric, glowing blue circles that create a sense of motion and depth. In the lower-left quadrant, a stylized compass rose is visible, with its points extending outwards. The overall color palette is various shades of blue, from light and airy to deep and vibrant.

noise &health

making the link

LONDON
HEALTH COMMISSION

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introduction

This booklet provides an introduction to the links between environmental noise and health. It offers an accessible reference point for those involved in the development of local noise or public health strategies.

Noise is generally defined as unwanted sound and is perceived as a pollutant and an environmental stressor¹. There are physical and psychological components to noise: whatever the physical characteristics of a sound may be, it will only become noise when it is unwanted.

Noise can have direct effects on hearing. In particular, exposure to excessive noise in industry may induce hearing loss. However, noise can also have adverse effects on other aspects of health. The links between environmental noise and health range from the annoyance and anxiety caused by noisy neighbours to the interference of aircraft noise in children's learning. These links are the subject of this booklet.

noise & health making the link

The booklet is based on a review of the current literature², undertaken to inform a health impact assessment of the Mayor of London's Draft Ambient Noise Strategy³. This was not a systematic review but a rapid review designed to draw together the available evidence on the links between noise and health. The scope of the review and of this booklet is the health impacts of environmental, or ambient, noise; it does not address the effects of occupational exposure to noise.

This review and the health impact assessment report are available on the London Health Commission website at www.londonhealth.gov.uk.

Policy links

Noise sources are increasingly controlled by international standards. These usually apply to aircraft, road vehicles and many types of equipment. Guideline values produced for the World Health Organization incorporate thresholds using the lowest noise level considered to affect health and well-being⁴.

The European Environmental Noise Directive on noise assessment and management was published on 18 July 2002, and the UK Government has set out a series of steps aimed at agreeing national policies on ambient noise by 2007. This includes mapping the main areas and sources of noise across England, work to establish adverse effects, techniques to improve or preserve conditions, economic analysis and prioritising actions.

This is a long process. The Mayor of London wishes to contribute constructively to it, as far as resources allow. The immediate priority of the draft London Ambient Noise Strategy, which was published in March 2003, is to use opportunities to take practical action where there is scope, and where

resources can be found. However, no-one should pretend that it will be quick and easy to reduce noise levels significantly across a big and busy city.

London does not yet have a proper estimate of the numbers of people exposed to different levels of ambient noise or of the costs of reducing noise to levels which would solve the problems people experience. It is not realistic to set timescales for achieving target reductions, until the necessary facts, budgets, incentives and legal powers are available. The Mayor will pursue these.

The overall vision for the Mayor's strategy is to minimise the adverse impacts of noise on people living and working in London using the best available practices and technology within a sustainable development framework.

The links between noise and health

Key areas of concern

Environmental noise affects health in a variety of different ways. There is good evidence for problems in the following areas^{5,6,7}:

- annoyance and quality of life
- sleep disturbance
- cardiovascular disease
- children's health
- higher noise levels between 65-70 dBA Leq may be risk factors for school performance and ischaemic heart disease.
- outdoor noise levels of 40-60 dBA Leq may disturb sleep

There is also more limited evidence of the adverse effects of noise on mental health.

These five key areas of concern are described below. The effects of noise on other vulnerable groups and the problems of noise in homes are also explored.

There is a fair degree of consensus about the safe levels of noise for these health impacts:

- environmental noise above 40-55 dBA Leq is likely to lead to significant annoyance.

The intensity (loudness) of sound is measured in decibels (dBA). Levels of environmental noise are often reported as averages over a sustained period (Leq). Other characteristics of sound include its frequency (pitch), periodicity (continuous or intermittent) and duration.

In general, intermittent, higher frequency, short duration, intense sounds have greater effects on health than do continuous, low frequency, long duration, low intensity sounds⁸, although low frequency sounds can also be an issue.

Annoyance and quality of life

The most widespread problem created by noise is simply annoyance. This can be a serious problem that may undermine quality of life, especially if noise makes people feel afraid or angry.

The extent to which people feel annoyed is partly determined by the basic characteristics of the noise. Annoyance with noise increases with its volume^{9,10,11} and pitch¹², and also, in less straightforward ways, with its duration and intermittency¹³. However, the context in which the noise is experienced is also important and feelings of annoyance will depend on how the noise interferes with daily life. For example, daily activities which involve talking and listening, such as conversation, watching television and listening to the radio, are especially affected by aircraft noise.

Noise is always a subjective experience and feelings of annoyance are profoundly affected by personal attitudes and beliefs, including attitudes to the source of the noise and to the environment in which it is heard. It is

because noise is commonly perceived to be an avoidable form of harm and an intrusion into personal privacy that it creates such unhappiness.

People who are fearful of the source of noise, who feel they have no control over it, or who believe that the relevant authorities fail to exercise control, are all likely to experience greater annoyance, especially if the noise has unpleasant meanings or associations. Noise may, for example, remind people of their isolation or social deprivation. However, noise may be easier to bear in circumstances where it is expected than in places where people expect tranquillity.

To some extent, people who experience on-going noise in their daily lives find ways of adapting and coping with the problem. But the problem remains: levels of annoyance with chronic noise tend to be sustained over time. People who are already stressed or anxious are likely to be more sensitive to the effects of intrusive noise than others.

Interventions to reduce the noise of road traffic, such as noise barriers, have been shown to reduce annoyance. Other approaches to reducing annoyance and improving quality of life include education campaigns targeting sources of noise which people find threatening and the creation of quiet green environments in urban settings.

Sleep disturbance

Noise can disturb sleep not only by waking people up but also by shifting them from deep to light sleep. Any sleep disturbance can have effects throughout the following day. People are good at adapting to nocturnal noise. Unfamiliar noises are far more likely to disturb sleep than familiar, regular patterns of noise. In laboratory studies, where participants are exposed to new, unexpected noises, sleep disturbance is much higher than in studies of people sleeping in their own homes.

The evidence suggests that air traffic is less likely to cause sleep disturbance than road traffic. Although people who live near airports are likely to attribute sleep problems to air traffic, UK evidence suggests they do not actually experience more sleep disturbance overall than anyone else¹⁴. Furthermore, no clear connection has been found between incidences of aircraft noise and actual sleep disturbance¹⁵. This certainly suggests that people are able to adapt to quite high levels of background noise.

Road traffic may be more of a problem because it is more changeable and less predictable. The time taken to fall asleep has been found to be affected not only by the intensity of road traffic noise but also by the number of incidences of traffic noise¹⁶. Living less

than 20 metres from a busy road has been found to predict insomnia¹⁷.

Insomnia and broken sleep are unpleasant experiences in themselves and, over the following day, they can lead to drowsiness, lower mood and poor performance, including slower reaction times. Road traffic has been found to cause all of these problems¹⁸. There is some evidence that noise during sleep can increase blood pressure and heart rate, but the significance of these effects for health is not known.

Longer term impacts of noise-related sleep problems are difficult to identify. Although sleep disturbance has been associated with coronary heart disease, it may be that people who have existing illness are more vulnerable to being woken by noise¹⁹.

Reductions in noise of 6-14 dBA have been shown to result in both subjective and objective improvements in sleep. REM (rapid eye movement) sleep and slow wave sleep also increase¹⁹.

Mental health

There is no strong evidence for a link between environmental noise and mental ill health. The clear association between noise and annoyance does not necessarily translate into a more serious

underlying relationship with mental health. However, if such a relationship does exist, it is likely to be complex and difficult to identify and measure.

Several studies have explored a possible association between living in a high noise area and psychiatric hospital admissions. The results have been mixed, suggesting that any relationship is likely to be indirect^{20,21}. More detailed research into the impact of aircraft noise has found a higher prevalence of certain symptoms such as tinnitus, minor accidents, irritability and depression in high noise areas²². However, there were no differences in the prevalence of psychiatric disorders, except among professionals and those who left education at age nineteen²³. A small relationship has also been found between road traffic noise and symptoms of mental health²⁴.

This evidence suggests that although noise can cause psychological symptoms, it does not play a major role in causing mental illness. Noise may moderate other factors or exacerbate existing experience of ill health – it is clear that people who have existing mental health problems are likely to be more sensitive to being annoyed or disturbed by environmental noise than the general population. However, annoyance can itself create minor psychological problems such as tension, irritability and difficulty concentrating.

In practice, any impact of noise on mental health will be mediated by individuals' attitudes to noise and the extent of their control, or perceived control, over the noise and the environment in which it is experienced. In many circumstances there may be other factors related to the source of the noise with a much greater potential impact on mental health.

Cardiovascular disease

Environmental noise is a risk factor for coronary heart disease, although it is relatively small when compared to other risk factors such as smoking.

Exposure to aircraft noise has been found to be linked to increased medical treatment for heart trouble and other cardiovascular problems²⁵. Similarly, road traffic noise has been linked to a small increased risk of coronary problems^{26,27}. Although there is little research in this area, these results are good enough to establish a credible link. This small risk factor applies to people who live with outdoor noise levels of more than 65-70 dBA.

Noise probably affects the cardiovascular system through the stimulation of hormones such as cortisol, noradrenaline and adrenaline. However, it is not clear how well people are able to adapt to these changes when they are exposed to loud noise over a long period.

Children's health

The effects of environmental noise on children are well established. Sustained noise at school or at home can lead to poor performance in a range of tasks related to cognition (thinking) and learning. Reading, attention, problem-solving and memory are most affected^{28,29,30,31}. This is consistent with wider research into the impact of environmental stresses.

The specific impacts of chronic aircraft, rail and road traffic noise on the cognitive performance of children are

- difficulty keeping attention,
- difficulty concentrating,
- poorer discrimination between sounds and poorer perception of speech,
- difficulty remembering, especially complex issues,
- poorer reading ability and school performance^{30,32}.

It is not entirely clear why chronic exposure to noise creates these problems. Noise is clearly a distraction from cognitive tasks, but if this distraction is on-going children may respond by filtering out the unwanted noise. Unfortunately, this strategy may result in children 'tuning out' indiscriminately, regardless of whether the noise is present. This may explain why children exposed to chronic noise have poorer attention, sound discrimination and speech perception.

These effects may in turn contribute to wider problems with cognitive tasks. In particular, research to date suggests that the effects of noise on child reading are due to problems making sense of sound and speech^{33,34,35}.

Although there has been little research into the impact on children of reducing noise, there is evidence that reductions in noise levels can improve cognitive problems after a year³⁶.

Other vulnerable groups

Noise is more likely to be a problem for people who have existing physical or mental illness than for other members of the general population. For example, patients in hospital who are exposed to high levels of noise have delayed recovery and wound healing⁵ and people with existing mental health problems are more prone to being annoyed by noise.

People who are ill, older people and people with existing sleeping difficulties are more likely to experience noise-related sleep disturbance, especially difficulty falling asleep. Older people are more likely to be awakened by noise at night. However, over 65s are least likely to report being bothered by neighbourhood noises, with younger age groups reporting more annoyance³⁷.

Although there may be many other groups who are especially vulnerable to the effects of noise, such as people living in deprived conditions or people with a family history of cardiovascular disease, there is little evidence in this area.

Domestic noise

Domestic noise is recognised as being a major source of annoyance in urban areas. Environmental noise spoils the home life of one in three people to some extent and totally spoils the home life of one in a hundred³⁸.

Noise from neighbours is probably the most serious problem. More people object to noise from neighbours, relative to the number of people who hear it, than noise from road traffic or aircraft. Overall, 70% of public complaints about domestic noise are about neighbours³⁹.

At a day-to-day level, domestic noise can disrupt people's lives in a variety of ways. Although annoyance is the most common response to noise, this is determined in part by the particular activities which are disturbed. Domestic activities such as sleeping, resting and

listening to the television or radio are most commonly disrupted and gardens are used less if there is too much noise. Noise is especially disturbing at night when background noise levels are lower and sleep may be affected by quieter sounds, especially sounds that have meaning for the listener.

In general, noise from neighbours can be a particular problem because of its potential to convey information and meaning, unlike other forms of noise. Such noise is more likely to elicit an emotional response such as anger, fear or depression. Although it is not clear whether domestic noise leads to psychiatric disorders, people with a history of mental health problems are more likely to be affected by noise⁴⁰.

Disturbance from neighbours is inevitably more common among flat-dwellers than among people living in semi-detached or detached houses. Other demographic factors are also relevant. Overall, those at higher risk from noise disturbance are characterised as being younger (25-34 years), with children, living in an attached property, particularly flats, rented from a local authority. The incidence of annoyance in this group is seven times higher than for people in upper age brackets, with no children, living in a property that is owned outright³⁷.

Summary

- Noise is defined as unwanted sound and is perceived as a pollutant. There are always both physical and psychological components to noise
- In general, intermittent, higher frequency, short duration, intense sounds have greater effects on health than do continuous, low frequency, long duration, low intensity sounds.
- The most widespread problem created by environmental noise is annoyance. This can undermine quality of life, especially if noise makes people feel afraid or angry.
- Annoyance often reflects the way that noise interferes with daily activities. It is also determined by people's attitudes to noise and the environment they live in. Noise is typically perceived to be an avoidable harm.
- Domestic noise is a major source of annoyance in urban areas. Noise from neighbours is the most common domestic noise problem and can be particularly difficult to cope with when it conveys information and meaning.
- Environmental noise is a cause of sleep disturbance. This can disrupt the quality as well as the quantity of sleep and lead to drowsiness, low mood and poor performance the following day.
- Road traffic and neighbours are the usual causes of noise-related sleep disturbance. These noises are changeable and unpredictable. Aircraft noise does not appear to be a major cause of sleep disturbance.
- It is unlikely that noise is a significant cause of serious mental health problems. However, noise annoyance creates minor psychological problems such as tension, irritability and difficulties concentrating.

- People who have existing mental health problems are likely to be more sensitive to being disturbed by noise. Similarly, older people and people with physical health problems may be more vulnerable.
- Environmental noise is a risk factor for coronary heart disease, although it is relatively small when compared to other risk factors such as smoking.
- Children's cognitive and learning skills can be affected by environmental noise. Reading, attention, problem-solving and memory are most affected.
- Background noise affects children's abilities to differentiate sounds and perceive speech because children tend to respond to noise by 'tuning out' all aural stimuli. This can lead to a wider range of cognitive problems.

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About the London Health Commission

The London Health Commission seeks to improve the well-being of all Londoners and reduce inequalities in health. The LHC promotes a co-ordinated approach to the factors that influence health in London, and will do this by:

- Building partnerships involving the health sector, local and national government, the private sector, community and voluntary groups
- Influencing decision-makers
- Supporting local action

To find out more about the work of the London Health Commission, see our website: www.londonhealth.gov.uk

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Health Impact Assessment (HIA)

HIA is an approach to ensure that decision making at all levels considers potential impacts on health and health inequalities, and identifies actions that can enhance positive effects and reduce or eliminate negative effects.

Although HIA is a new and developing approach, it is increasingly being recognised nationally and internationally.

Developing and promoting the use of HIA is one of the supporting priorities of the London Health Commission.

A number of resources are now available to support those considering or conducting health impact assessments. Please see our website at: www.londonhealth.gov.uk/hia.htm

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