

Noise and Health

Continuing concerns on the effects of noise on health have been responded to by the UK Department of Environment, Transport and the Regions (DETR), which requested the National Physical Laboratory (NPL) and the Institute of Sound and Vibration Research (ISVR) to review the noise standards used within Europe for assessing the health impact of environmental noise. An aim of this work was to advise the DETR of the extent to which existing knowledge on potential health effects could be used to define future noise standards and targets.

Studies have shown that there are a number of potential effects of noise on health, although the evidence in support of actual health effects, other than those based on reported bother or annoyance and on some indicators of sleep disturbance, is quite weak. There is evidence that thresholds exist below which it is unlikely that there is an impact on health, but these are not definitive. Standards and regulations are influenced by both the results of primary research and by those social, political and historical factors which are relevant to the problem.

Objectives

The main objectives of this study were to:

- (1) evaluate available information on health effects in order to establish noise levels at which there may be particular effects on the population, and from this,
- (2) advise on the feasibility of establishing effects-based standards which could be used to inform the setting of objectives and targets.

The authors of the Report set themselves the twin aims of reviewing current standards and literature on noise criteria and limits, whilst also 'interpreting' the WHO 1995 fairly stringent guidance limits given in 'Community Noise'.²

Effects of Noise on Health

The literature points to some health effects which are credibly substantiated and others for which the evidence is weak, if not dubious.

The substantiated effects of environmental noise include:

- Annoyance, which increases as exposure increases.
- Speech interference.
- Sleep disturbance, to which many can habituate, although the relation between sleep loss and health is not clearly understood.
- There is also some evidence for ischaemic heart disease.

Effects for which the evidence is inadequate include:

- Psychiatric disorders,
- Cardiovascular disease,
- Hypertension,
- Effects on the immune system,
- Biochemical and congenital effects.

The authors comment that "In general, it is only the most poorly designed and executed results which show significant effects", whilst admitting that the absence of proof should not be taken as an absolute negative. So the authors' opinion is that, apart from the obvious annoyance and similar effects, the evidence is either too thin or not yet available to substantiate problems at a deeper level.

Noise and Stress

Consideration is also given to noise induced stress-related effects.

Individual reactions to a stressor can be of a psychological, behavioural or somatic nature. Some behavioural responses may be positive, since a certain amount of noise can contribute to beneficial arousal. Increased arousal assists with task motivation and thereby improves performance, depending on the individual concerned. On the other hand, excessive stress is, by definition, 'excessive' and the literature reports a number of possible stress-related adverse effects of too much environmental noise.

Psychological effects concern

feelings of fear, depression, frustration, irritation, anger, helplessness, sorrow and disappointment. Behavioural reactions to a stressor include social isolation, aggression, excessive use of alcohol, tobacco, drugs or food. Psychological and behavioural stress could have direct or indirect effects on physiological processes in the body. In the absence of any more definitive results, many studies have implicitly assumed that noise could be considered as an unspecified stressor leading to over-stimulation of the central nervous and endocrine systems.

Potential indicators of health impact due to stress-related effects appear in the literature, but are not necessarily proven, including changes in blood pressure, abnormalities in the electrocardiogram, rates of diagnosing clinical hypertension, occurrence rates of ischaemic heart disease and other cardiovascular disorders, biochemical effects, changes in the immune system and effects on the unborn child, such as birthweight effects and incidence rates for various congenital defects.

The Evidence

As the evidence in support of potential health effects other than annoyance is weak, it is not at present possible to define meaningful exposure-response relationships for these other effects. Non-acoustic factors are also important in determining a response and serve to add variability to the data. Although the scientific evidence suggests

thresholds below which it is unlikely that there is an impact on health, these cannot be interpreted as definitive in the present state of knowledge.

The general link between an effect and its impact on health is even more complex, and depends on many aspects. These include modification of one effect by another, the role of other modifiers and confounding variables, the number of effects, cumulative noise exposures, the susceptibility of individuals and the risk factors associated with multiorigin health conditions.

Targets and Criteria

The actual practical setting of existing criteria and targets as opposed to criteria based solely on primary scientific research evidence is also considered. Practical noise targets are a compromise between the desirable and the affordable. The desirable relates to the thresholds suggested by the scientific evidence below which no effect is expected. The affordable involves weighing the costs and

benefits in monetary and social costs. Practical noise limits are usually based above these lower desirable thresholds. They take the results of primary research into account to some extent, but social, political and historic factors are at least as important.

It is concluded that given the present state of knowledge, it would be unwise to base future environmental noise standards and regulations on what are at present hypothesised non-auditory health effects, until future research can make the present confused situation clearer.

However, greater transparency in the way in which future standards and regulations are developed will enable the public to become more aware of both the strengths and limitations of these standards. An increased emphasis on non-auditory health effects, as opposed to annoyance, as the outcome variable may lead to this greater transparency. Nonauditory health effects cannot be included in the development of future standards without further carefully designed research.

Interpretation of the WHO guidelines

In 1980, the World Health Organisation published Environmental Health Criteria No. 12, Noise, introducing noise limits, which have been widely used in setting standards and criteria in a number of areas, although they have no official status. The WHO describes its report as containing "... the collective views of an international group of experts and does not necessarily represent the decisions or the stated policy of either the World Health Organisation or the United Nations Environment Programme".

More recently, Berglund and Lindvall published an updated 'Community Noise' document for the World Health Organisation, setting out revised noise limit guidelines. Certain criteria have been revised in the light of accumulated scientific knowledge since the publication of the original Environmental Health Criteria document in 1980. The Foreword to the new document states: 'Thus, although the document is the amalgamated result of the work of a large number of persons, the complex and extended work process

Effect to be avoided	Effect Criterion	1980	1990
Speech Interface	100% Intelligibility	45LAeq	35dBA
	reasonable intelligibility		45dBA
	loud speech understood		55dBA
Noise induced hearing loss	negligible risk	75LAeq, 8hrs	75LAeq, 8hrs
	increasing risk	140dB	130–150 dB(Peak)
Sleep disturbance	electrophysiological effects	35LAeq	30LAeq
			45LAmax
Cardiovascular disease		more research needed	more research needed
Performance effects	cognitive tasks	no specific criteria	
	startle effects		no specific criteria
	reading skills in children		no specific criteria
Thresholds of reported annoyance	moderate annoyance		50LAeq
	serious annoyance	50LAeq	55LAeq
Social behaviour	reduced helping behaviour		80dBA

makes it necessary to declare that the editors are solely responsible for the present text of the document'. The guideline values contained in the document have not been adopted by the WHO or by any other official body, although this does not have any effect on their underlying scientific validity as determined from the available research data.

The WHO guideline values in the 1980 and the 1995 WHO documents are shown in Table 1. The differences between the 1980 and 1995 documents are compared critically in the NPL report, particularly in relation to speech interference and sleep disturbance, although it is stressed that both of these documents represent the views of the then panels of experts, as interpreted by the different editors of the documents, whilst separated by fifteen years of development, expectations and Appraisal.

The WHO documents do not have any official status. The guideline values

in each case are based on a consensus reached by an invited group of international experts in the field, which lends them credibility, but, in such a complex field, there will be disagreement between experts. Any attempt at formal ratification of the guideline values by any form of international voting would face difficulties, although both documents have value as a careful and detailed analysis of the available literature. The guidelines provide useful guidance as to the lower threshold levels below which residual noise impacts can probably be considered as negligible.

Conclusions

The author's conclusions are

- Given the present state of knowledge, it would be unwise to base future environmental noise standards and regulations on what are at present hypothesised non-auditory health effects until

future research can make the present confused situation clearer.

- To ensure that non-auditory health effects are included in future standards, research is required. This must be carefully designed, not only in terms of its planning and execution, but also in terms of setting precisely defined and achievable objectives.
- The WHO documents give threshold values below which noise effects should be negligible, although many people are already exposed to levels in excess of the WHO precautionary values without suffering adverse effects.

THE CROWD ROARS

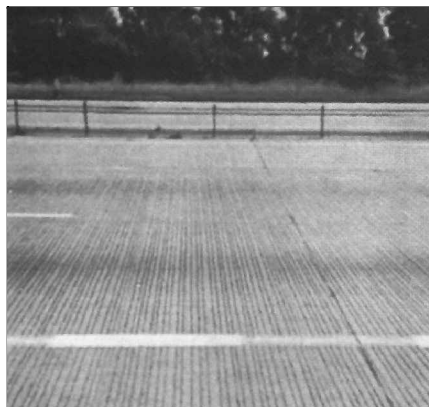
A Premiership soccer crowd celebrating a goal roars as loudly as a Harrier jet taking off tests by environmental health officers at an Ipswich Town game have shown.

Thin layers - less noise

Mike Wright, of W.S. Atkins, reviews the latest developments in road surfaces and calls for a revision to the UK noise prediction method and further testing

When considering mitigation measures for a scheme, some account must be taken of the benefits of new technology.

Calculation of Road Traffic Noise (CRTN) is now 11 years old and remains one of the most comprehensive and reliable methods of predicting road traffic noise. However, it is now starting to show its age because there are new ways of reducing noise.



Random groove concrete on A46 Kenilworth bypass prior to resurfacing

Recent developments have been most evident in new types of road surfaces. While CRTN allows you to calculate for concrete, bituminous and porous asphalt surfaces and can take into account surface texture in the first two types, it takes no account of the different types of porous asphalt that can be laid. The method does not even consider thin surface overlays because they were not commercially available in 1988 when it was published. These products are a much cheaper alternative, and are thinner and stronger than porous asphalt. Not surprisingly, they are rapidly gaining popularity in the UK.

A question asked regularly is just how you calculate levels of noise from new surfacing products. CRTN is the method prescribed in the Noise