Evidence briefing for the Transport Health and Environment Pan-European Programme (THE PEP) toolbox: Road transport noise

Indicator

Road transport noise

Overview

Noise caused by road, rail and air transport is the most important source of community noise in Europe. Exposure to community noise affects people's health and well-being in various ways: it can disrupt communication, affect sleep quality, cause annoyance and reduce performance. Prolonged or excessive exposure to noise (e.g. 65-70 dB (LAeq)) can cause hypertension. Some studies suggest an association between noise exposure and an increased cardiovascular health risk. In children, noise exposure not only causes annoyance, it also affects their ability to learn (cognition) (WHO, 2007; Van Kempen, 2007). Transport noise is a major public health issue because so many people are constantly exposed to it. In general, successful policy options to reduce exposure to transport noise consist of a combination of spatial planning, measures to influence modal split and behaviour, technical solutions and financial instruments. Cost-benefit analyses show that the benefits of reducing noise emitted by cars and trains exceed the costs. Tightening noise emission limits for car tyres is the easiest and cheapest way of reducing noise levels. 'Silent' tyres also produce fewer particles and are more energy efficient.

Definitions

- L_{Aeq}: A-weighted average sound pressure level.
- dB(A): Unit of A-weighted sound pressure level, where A-weighted means that the sound pressure levels in various frequency bands across the audible range have been weighted in accordance with differences in hearing sensitivity at different frequencies.
- $L_{Aeq\ T}$: Exposure to noise for the duration of a given time interval T (e.g. 24-hour period, one night, one day) is expressed as an equivalent sound pressure level (measured in dB(A)) over the interval in question.
- L_{den}: The Day-Evening-Night level is the equivalent sound level over 24 hours, with the sound levels in the evening increased by 5 dB(A) and during the night by 10 dB(A).
- DALY: Disability-adjusted life-year. This integrated health measure combines information on quality and quantity of life. It provides an indication of the (potential) number of healthy life-years lost in a population due to premature mortality or morbidity, the latter of which is weighted for the severity of the disorder.

What's the problem? Key facts

Since noise is a pollutant that is persistent and inescapable, a significant proportion of the population is exposed to it. About 40 per cent of the population in the EU-15 countries is exposed to daytime road-traffic noise at levels above 55 dB(A), and 20 per cent to levels above 65 dB(A). More than 30 per cent is exposed to nighttime levels above 55 dB(A) (WHO, 2007). The World Health Organization's (WHO) guidelines on

community noise limit noise levels for residential areas to 55 dB(A) outdoors during the day and to 45 dB(A) indoors during the night.
Noise level distributions in the EU vary widely as is shown in Figures 1 and 2. These figures are merely indicative due to the differences in noise assessment methodologies in the countries.

During the last decades, exposure to high noise levels has decreased substantially in some EU countries due to technological and spatial measures (e.g. road surface, noise barriers, silent tyres) (Staatsen et al., 2004). Nevertheless, the expected increase in traffic and the growing share of population living in urban environments means that noise will continue to be a problem. Noise levels are increasing in EECCA countries as a result of industrial growth and increasing levels of transport activity. Older vehicle fleets in EECCA and SEE countries also contribute to higher noise levels (Dimitrov, 2004). The noise levels stated in the WHO's guidelines on noise are often exceeded in EECCA and SEE countries on roads with high traffic loads (UN-ECE-WHO, 2008). In Moscow, for example, noise from heavy traffic on urban motorways can exceed 80 dB. Motor vehicles and aircraft are the main contributors to transport noise.

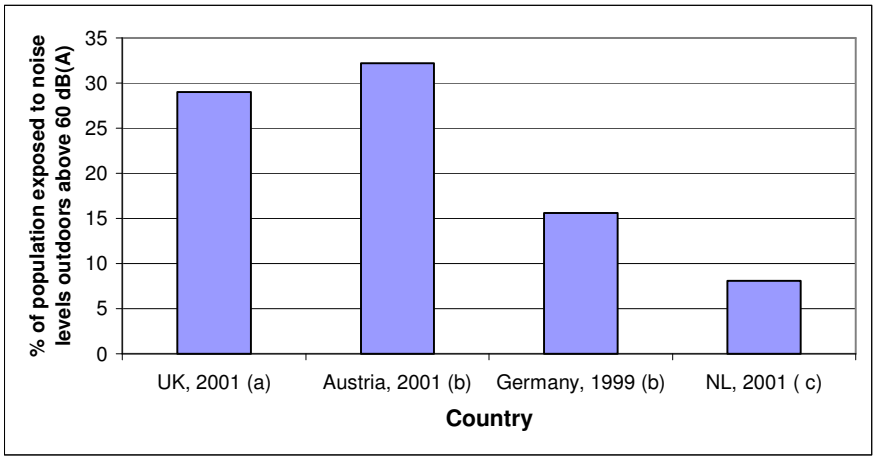

Figure 1: The percentage of the population exposed to noise levels > 60 dB(A) in different European countries. (a) Based on 24-hr measurements; (b) Daytime level only; (c) Lden level. See also: Uncertainties.

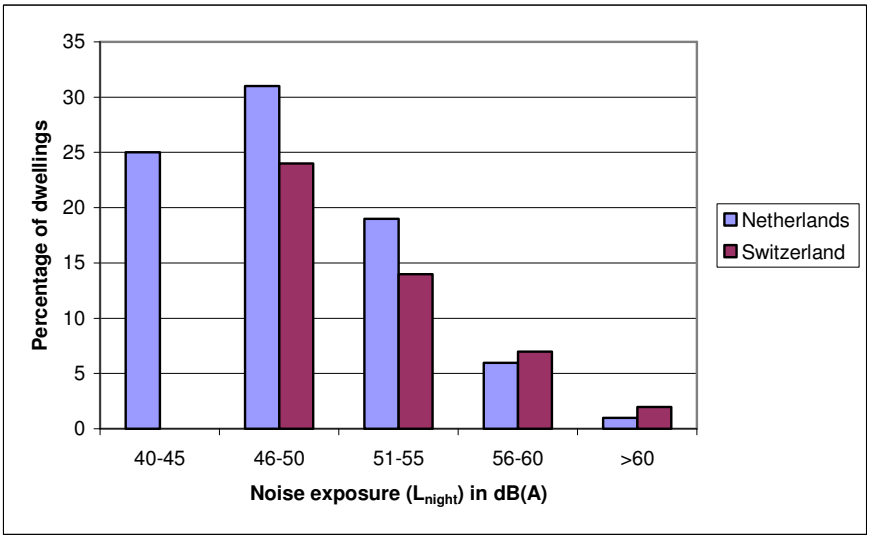

Figure 2: The percentage of homes per noise exposure class in the Netherlands and Switzerland. Source: EU, 2007.

Compared with noise from neighbours and industry, a large proportion of people are severely annoyed by noise from transport sources (road, rail or air traffic). However, due to differences in the measurement of annoyance and the definition of sources, it is only possible to make an indicative comparison between countries and regions, as shown in Figure 3.

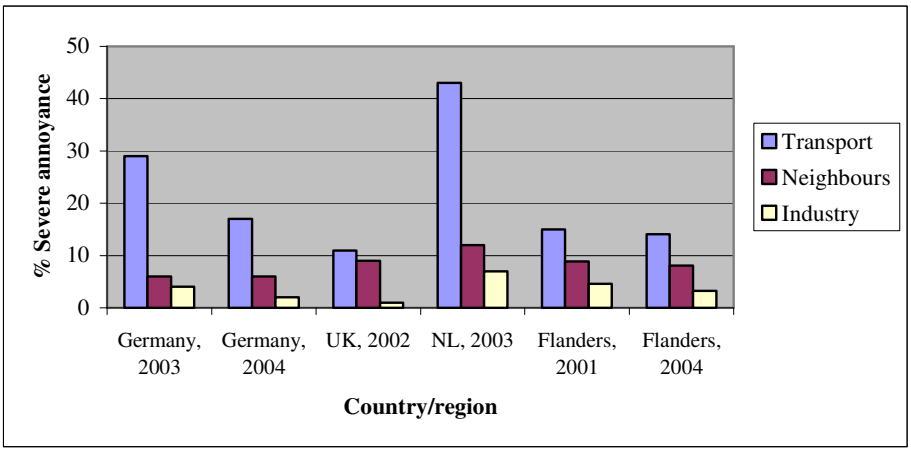

Figure 3: The percentage of severe annoyance measured in several European studies (Franssen et al., 2004; Grimwood et al., 2002; Umweltbundesamt 2003/2004; MIRA, 2005). See also uncertainties.

Several studies have estimated the burden of disease attributable to noise exposure (Knol et al., 2005; Torfs, 2003). Compared with environmental factors such as air pollution, radon, and UV radiation, the disease burden attributable to annoyance, sleep disturbance and cardiovascular diseases caused by noise exposure is considerable, as is shown in Figures 4 and 5. It has also been estimated that 3.2 per cent of myocardial infarctions in Germany may be attributable to exposure to road-traffic noise (Babisch, 2006).

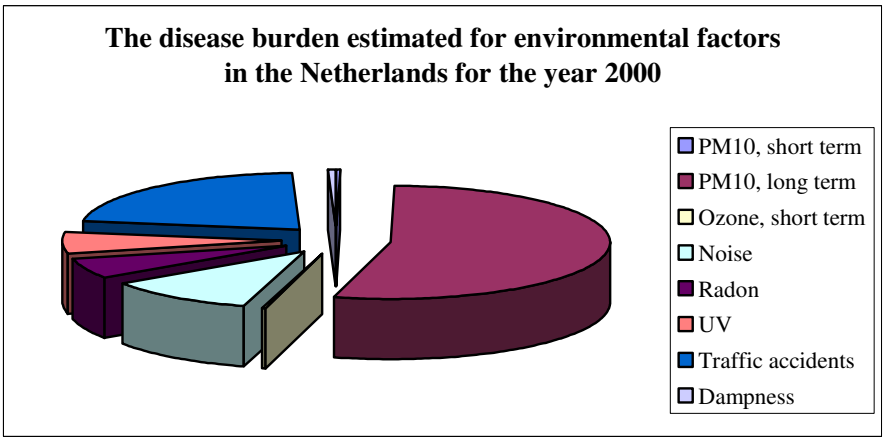

Figure 4: The environmental disease burden in the Netherlands (based on Knol et al., 2005). The disease burden is expressed in the number of DALYs per million people.

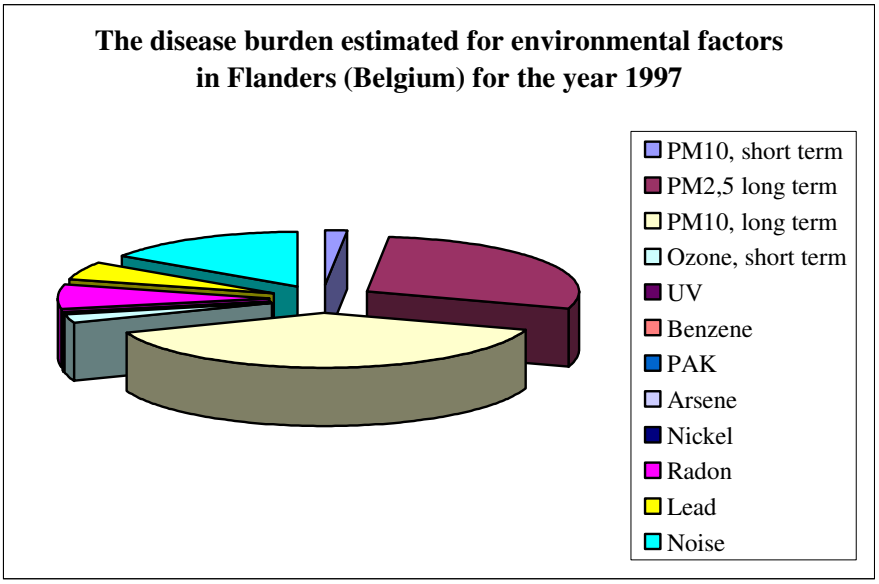

Figure 5: The environmental disease burden in Flanders (based on Torfs, 2003). The disease burden is expressed in the number of DALYs.

Data on population exposure and the attributable noise burden from the central and eastern areas of the WHO region are scant.

What are potential policy solutions?

In general, successful policy options consist of a combination of spatial planning, technical solutions and measures to influence modal split and behaviour (often with financial instruments). Potential policy solutions could consist of:

- Tightening EU guidelines, especially regulations for tyres.
- Promoting eco-driving and educating driving instructors and drivers, including field tests showing actual travel time at different travel speeds.
- Traffic calming measures, for example, reducing speed limits on motorways
- Measures influencing traffic volume in residential areas. In general, policy aimed at influencing modal split is only marginally successful. Nevertheless, there are promising practices of schools and businesses promoting biking and walking
- Nighttime regulations for lorries, noisy trains and aircraft in and over residential areas (see also Night Noise Guidelines (2007)).
- Protection measures such as positioning noise-sensitive rooms on the quiet side of homes (see also Night Noise Guidelines (2007)).
- Developing objectives for urban and transport planning concerning the design of quiet areas, the location of schools and homes in relation to busy roads, railways and airports. Zoning is an instrument that planning authorities can use to keep noise-sensitive projects away from noisy areas.
- Further developing and enforcing (innovative) technological measures to reduce emissions at the source and exposure, such as low-noise road surfaces and tyres.
- Investigating the possibilities of teleworking.
- A child-friendly mobility plan, with attention for infrastructure and education measures promoting safe walking and biking for children and their parents (e.g. the walking bus).

- Financial instruments such as levies and taxes on noisy vehicles, noisy tyres etc.

Costs and benefits

The benefits (in terms of better health and less annoyance) of abating the noise created by cars and trains exceed the costs of the measures, as some cost-benefit analyses clearly indicate:

- For the EU-27, the benefits of reducing traffic noise levels by 1 dB by, for example, by using more silent tyres are estimated at €5.8 billion annually (FEHRL, 2006).
- The estimated cost of reducing noise created by cars and trains in the Netherlands was about €2 billion, whereas the benefits in terms of reduced annoyance were estimated at €4 to 6 billion (Staatsen et al., 2004). Making road traffic more silent (as opposed to constructing noise barriers, for example) is the most effective way of reducing road-traffic noise (Staatsen et al., 2004; Nijland, 2008).
- An analysis of Stated Preference (SP) studies on road-traffic noise suggests an interim EU-wide economic value of €23.5 per dB(A) per household per year (Navrud, 2003).
- The EU-funded project, UNITE, derived monetary values for noise-related health impacts such as myocardial infarction, angina pectoris, hypertension and sleep disturbance (Bickel, 2001).
- Equity should also be included in the cost-benefit analysis of policy measures. In the Netherlands, for example, low-income groups are more often exposed to high noise levels.

What are the potential tools for action?

- Promote the discussion between stakeholders, such as the traffic sector, land use and urban planner and health specialists.
- Map and monitor the noise exposure of the population according to the EU Environmental Noise Directive. European member states are obliged to make these maps for all agglomerations, major roads and airports by 2007/2008.

Uncertainties

- International comparisons of noise levels in different countries are mainly hampered by differences in the input data necessary to assess noise exposure and by differences in calculation methods (Nijland, 2007). The efforts prescribed by the EU Environmental Noise Directive are expected to bring improvements.
- (International) comparisons of annoyance rates are hampered by differences in the measurement and definition of annoyance. To overcome these problems, ICBEN and ISO have developed standard questions, which became available in 2001 (ISO, 2003).
- Noise is associated with effects on the cardiovascular system but epidemiological evidence is still limited. The no-effect thresholds (reference levels) are still debatable. Several risk estimates are available, which can be used as indications for further health impact assessments (Babisch, 2006; Van Kempen et al., 2007, Kahlmeier et al, 2009).

Relevant websites

- www.walkingbus.com
  A child-friendly mobility plan.
- http://www.calm-network.com/index
  An overview of European noise abatement studies.

- http://www.innovatieprogrammageluid.nl
  The Dutch Noise Innovation Programme develops measures to tackle traffic noise and make Dutch railways quieter.
- http://ec.europa.eu/environment/noise/home.htm#2
  Website of the European Commission on noise legislation and implementation. The EU Environmental Noise Directive is also available on this website.
- http://www.its.leeds.ac.uk/projects/unite/
  The Fifth Framework project Unification of accounts and marginal costs for transport efficiency (UNITE).
- http://www.euro.who.int/noise/
  WHO noise and health website, which contains a lot of information on the effects noise has on health. It also contains the WHO guidelines on community noise.
- http://www.envit.de/umweltdaten/jsp/index.jsp
  Umweltbundesamt. Noise annoyance rates for Germany.
- http://www.euro.who.int/noise/activities/20030123_1
  'Noise and health' website of the World Health Organization. Last visited January 22, 2007.

References

Babisch W (2006). *Transportation noise and cardiovascular risk. Review and synthesis of epidemiological studies. Dose-effect Curve and Risk Estimation.* Umweltbundesamt. WaBoLu Hefte 01/06. Download from: http://www.umweltdaten.de/publikationen/fpdf-l/2997.pdf.

Bickel P, Schmid S, Friedrich R, Krüger R, Droste-FranckeB, Krewitt W, Doll C (2001). *Pilot accounts environmental costs, Germany 1998.* Contribution to D5 of the UNITE project funded under the Fifth EU Framework Programme by DGTREN. IER, University of Stuttgart.

Dimitrov, P. (2004). *Overview of the environmental and health effects of urban transport in the Russian Federation and the other countries in Eastern Europe, the Caucasus, and Central Asia.* Conference on Implementing Sustainable Urban Travel Policies in the Russian Federation and Other CIS Countries. 30 September – 1 October 2004. Download from: http://www.internationaltransportforum.org/europe/ecmt/urban/Moscow04/Dimitrov.pdf

FEHRL (2006), Final report S12.408210 Tyre/Road Noise – Volume 1. 25, Brussels. Download from: http://ec.europa.eu/enterprise/automotive/projects/report_tyre_road_noise1.pdf

Franssen EAM, Dongen JEF van, Ruijsbroek JMH, Vos H, Stellato RK (2004). *Hinder door milieufactoren en de beoordeling van de leefomgeving in Nederland. Inventarisatie verstoringen 2003.* RIVM report no. 815120001/2004. Download from: http://www.rivm.nl/bibliotheek/rapporten/815120001.pdf.

Grimwood CJ, Skinner CJ, Raw GJ (2002). *The National Noise Incidence Study 2000/2001(United Kingdom). Volume 1: Noise Levels.* BRE, Watford UK. Client report number 206344f. Download from: http://www.defra.gov.uk/environment/noise/research/nis0001/pdf/nis_vol1.pdf.

International Organization for Standardisation (ISO). *Technical Specification ISO/TS 15666 Acoustics – Assessment of noise annoyance by means of social and socio-acoustic surveys (2003).* Reference: ISO/TC 43/SC 1 N 1313.

Kahlmeier et al, (2009). *Economic valuation of transport-related health effects – Summary.* WHO Regional Office for Europe, Copenhagen. Download from: http://www.euro.who.int/Document/Trt/PEP_EconValSum.pdf

Kempen EEMM van (2007). *Transportation noise exposure and children's health and cognition.* Thesis, ISBN 978-90-393-47355.

Knol AB, Staatsen BAM, Overveld AJP van, Ameling CB. *Trends in the environmental burden of disease in the Netherlands, 1980-2020.* Bilthoven: RIVM, 2005. RIVM report no. 609110001/2005. Download from: http://www.rivm.nl/bibliotheek/rapporten/500029001.pdf.

Navrud S (2003). *State-of-the art on economic valuation of noise.* ECE/WHO 'Pan-European Programme on Transport, Health and the Environment', Workshop on the Economic Valuation on Health Effects due to Transport, June 12-13, 2003, Stockholm.

Nijland H. (2008) *Theory and practice of the assessment and valuation of noise from roads and railroads in Europe.* T2008/10, TRAIL Thesis Series, The Netherlands

Staatsen B, Nijland H, Hollander AEM de, Kempen E van, Franssen E, Kamp I van (2004). *Assessment of health impacts and policy options in relation to transport-related noise exposures.* RIVM report no. 815120002/2004. Download from: http://www.rivm.nl/bibliotheek/rapporten/815120002.pdf

Torfs R (2003). *Kwantificering van gezondheidsrisico's aan de hand van DALYs en externe gezondheidskosten.* Vito, MIRA/2003/02. Download from (in Dutch only): http://www.milieurapport.be/Upload/Main/MiraData/MIRA-T/03_GEVOLGEN/03_01/MENS_O&O_03.PDF.

UNECE-WHO (2008). *Transport, Health and Environment: trends and developments in the UNECE-WHO European Region (1997-2007).* Prepared under the auspices of the Transport, Health and Environment Pan-European Programme. United Nations Economic Commission for Europe and World Health Organization Regional Office for Europe. Geneva, 2008.

World Health Organization (2000). *Guidelines for community noise.* Edited by: Berglund B, Lindvall T, Schwela DH, Goh KT. Geneva: World Health Organisation, Guideline Document.

World Health Organization (2007). *Guidelines for the exposure to noise at night.* Edited by: Berg M van den. World Health Organization Europe.

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