APPENDIX 17.3.2: SUMMARY OF LITERATURE REVIEW STUDIES ON ENVIRONMENTAL NOISE AND NON-AUDITORY HEALTH EFFECTS

Authors	Title	Design	Threshold Value	Major Findings/Weaknesses	Abstract	Citation
Tomas Hellmuth, Thomas Classen, Roko Kim, and Stylianos Kephalopoulos Reference #11	Methodological Guidance For Estimating the Burden of Disease from Environmental Noise	Guidance	Not Applicable	When the DALY concept is applied, the fundamental uncertainties affecting each step in its calculation must be borne in mind. Because of these uncertainties, both case number estimations and DALY calculation results must be interpreted with caution. This is of particular importance when the results are communicated to stakeholders and policy-makers and disseminated to the public.	The World Health Organization, supported by the European Commission's Joint Research Centre, is issuing **this technical document as guidance for national and local authorities in risk assessment and environmental health planning related to environmental noise.** The principles of quantitative assessment of the burden of disease from environmental noise, the status of implementation of the European Noise Directive, and lessons from the project on Environmental Burden of Disease in the European countries (EBoDE) are summarized, together with a **review of evidence on exposure–response relationships between noise and cardiovascular diseases. Step-by-step guidance is presented on how to calculate the burden of cardiovascular diseases and sleep disturbance.** The limitations and uncertainties of estimating disability-adjusted life years and the usefulness and limitations of noise map data are discussed.	World Health Organization, 2012. "Methodological guidance for estimating the burden of disease from environmental noise." Copenhagen, WHO Regional Office for Europe. (http://www.euro.who.int/__data/assets/pdf_file/0008/179117/Methodological-guidance-for-estimating-the-burden-of-disease-from-environmental-noise-ver-2.pdf Accessed January 21, 2013)
Stéphane Perron, Louis-François Tétreault, Norman King, Céline Plante, and Audrey Smargiassi Reference #12	Review of the effect of aircraft noise on sleep disturbance in adults	Discussion of the findings of multiple research documents	Not Applicable	Their systematic review demonstrated that aircraft noise events (ANE) have impacts on sleep disturbances. All studies of moderate to high quality performed to date showed a positive association between increases in aircraft noise exposure and the deterioration of sleep outcomes. As the sound levels increase, the probability of awakening increases and awakening times last for longer periods. Individuals exposed to higher levels of noise have been shown to have shorter periods of SWS. The use of over-the-counter sedative or sleep medication increased in the presence of ANE occurring in the evening. Hence, noise events were linked to sleep disturbance in all moderate- to high-quality studies using different designs and measures.	Noise exposure generated by air traffic has been linked with sleep disturbances. **The purpose of this systematic review is to clarify whether there is a causal link between aircraft noise exposure and sleep disturbances.** Only complete, peer-reviewed articles published in scientific journals were examined. Papers published until December 2010 were considered. To be included, articles had to focus on subjects aged 18 or over and include an objective evaluation of noise levels. Studies were classified according to quality. Given the paucity of studies with comparable outcome measures, we performed a narrative synthesis using a best-evidence synthesis approach. The primary study findings were tabulated. Similarities and differences between studies were investigated. **Of the 12 studies surveyed that dealt with sleep disturbances, four were considered to be of high quality, five were considered to be of moderate quality and three were considered to be of low quality**. All moderate- to high-quality studies showed a link between aircraft noise events and sleep disturbances such as awakenings, decreased slow wave sleep time or the use of sleep medication. **This review suggests that there is a causal relation between exposure to aircraft noise and sleep disturbances.**	Perron, Stéphane, Louis-François Tétreault, Norman King, Céline Plante, and Audrey Smargiassi. "Review of the effect of aircraft noise on sleep disturbance in adults." *Noise & Health* 14, no. 57 (2012): 58-67.

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					However, the evidence comes mostly from experimental studies focusing on healthy adults. Further studies are necessary to determine the impact of aircraft noise on sleep disturbance for individuals more than 65 years old and for those with chronic diseases	
Sabine A. Janssen, Henk Vos, Elise E. M. M. van Kempen, Oscar R. P. Breugelmans, and Henk M. E. Miedema Reference #23	Trends in aircraft noise annoyance: The role of study and sample characteristics	Technical Report	Not Applicable	A significant increase over the years was observed in annoyance at a given level of aircraft noise exposure.	Recently, it has been suggested that the annoyance of residents at a given aircraft noise exposure level increases over the years. The objective of the present study was to verify the hypothesized trend and to identify its possible causes. To this end, the large database used to establish earlier exposure-response relationships on aircraft noise was updated with original data from several recent surveys, yielding a database with data from **34 separate airports**. Multilevel grouped regression was used to determine the annoyance response per airport, after which meta-regression was used to investigate whether study characteristics could explain the heterogeneity in annoyance response between airports. **A significant increase over the years was observed in annoyance at a given level of aircraft noise exposure.** Furthermore, the type of annoyance scale, the type of contact, and the response percentage were found to be sources of heterogeneity. Of these, only the scale factor could statistically account for the trend, although other findings rule it out as a satisfactory explanation. No evidence was found for increased self-reported noise sensitivity. **The results are of importance to the applicability of current exposure-annoyance relationships for aircraft noise and provide a basis for decisions on whether these need to be updated.**	Janssen, Sabine A., HenkVos, Elise E. M. M. van Kempen, Oscar R. P. Breugelmans, and Henk M. E. Miedema. "Trends in aircraft noise annoyance: The Role of Study and Sample Characteristics. "*Journal of The Acoustical Society Of America* 129, no. 4 (2011): 1953-1962.
K Jones, Civil Aviation Authority (UK). Environmental Research and Consultancy Department Reference #25	Environmental Noise and Health: A Review	Best Practices	Not Applicable	This review provides an overview of literature in the field of noise and health. It focuses on transportation noise, particularly aircraft noise and looks at the possible effects on health to include annoyance and psychological health, cardiovascular and physiological health, performance, and the effects of noise on children. Suggestions for future research areas are given.	A literature review was undertaken of the scientific knowledge on the subject of 'environmental noise and health', with particular reference to aircraft noise. The World Health Organisation Guidelines for Community Noise (1999) were taken as the basis for the review, and a literature search was carried out for key papers published after the WHO Guidelines and for review papers published since the late 1990s. The WHO Night Noise Guidelines for Europe, published in October 2009 are also referred to in terms of recommended night noise limits and health effects.	Jones, K. February 2010. "Environmental Noise and Health: A Review." Civil Aviation Authority (UK). Environmental Research and Consultancy Department, ERCD Report 0907.
W. Babish (e), G. Dutilleux, M. Paviotti, A. Backman, B.	Good Practice Guide on Noise	Good Practice Guide	Depends on the healthpoint:		This document presents current knowledge about the health effects of noise, and provides	W. Babish (e), G. Dutilleux, M. Paviotti, A. Backman, B. Gergely,

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Gergely, B. McManus, L. Bento Coelho, J. Hinton, S. Kephalopoulos, M. van den Berg (e), G. Licitra, S. Rasmussen. N. Blanes, C. Nugent, P. de Vos, A. Bloomfield Reference #31	Exposure and Potential Health Effects		Annoyance = 42 Lden, Self-reported Sleep Disturbance = 42Lnight; LEarning = Leq50; Sleep = Lmax indoor 32; Reported awakening =SELindoors 53; Reported Health and hypertension = Lden 50; IHD = Lden 60		end users with practical tools to estimate the health impacts of noise exposure. The paper also provides formulaic approaches to calculating noise impacts on the different health points caused by aircraft noise. The document presents this information as guidance in the development of noise studies or EISs within the guidelines of the European Environment Agency's Directive 2002/49/EC on the assessment and management of environmental noise.	B. McManus, L. Bento Coelho, J. Hinton, S. Kephalopoulos, M. van den Berg (e), G. Licitra, S. Rasmussen. N. Blanes, C. Nugent, P. de Vos, A. Bloomfield. "Good Practice Guide on Noise Exposure and Potential Health Effects." EEA Technical Report No. 11/2010, October 2010. (http://www.eea.europa.eu/publications/good-practice-guide-on-noise Accessed January 21, 2013)
Wolfgang Babisch, Danny Houthuijs, Göran Pershagen, Ennio Cadum, Klea Katsouyanni, Manolis Velonakis, Marie-Louise Dudley, Heinz-Dieter Marohn, Wim Swart, Oscar Breugelmans, Gösta Bluhm, Jenny Selander, Federica Vigna-Taglianti, Salvatore Pisani, Alexandros Haralabidis, Konstantina Dimakopoulou, Ioannis Zachos, Lars Järup, and HYENA Consortium Reference #33	Annoyance due to aircraft noise has increased over the years—Results of the HYENA study	Not applicable	Not applicable	This document reviews the results of the HYENA study. The results indicate that annoyance due to aircraft noise has increased throughout the recent years, and that the current EU prediction curve for aircraft noise annoyance should be modified.	In the **HYENA study (HYpertension and Exposure to Noise near Airports)** noise annoyances due to aircraft and road traffic noise were assessed in subjects that lived in the vicinity of 6 major European airports using the 11-point ICBEN scale (International Commission on Biological Effects of Noise). A distinction was made between the annoyance during the day and during the night. Lden and Lnight were considered as indicators of noise exposure. Pooled data analyses showed clear exposure–response relationships between the noise level and the noise annoyance for both exposures. The exposure–response curves for road noise were congruent with the EU standard curves used for predicting the number of highly noise annoyed subjects in European communities. Annoyance ratings due to aircraft noise, however, were higher than predicted by the EU standard curves. The data supports other findings suggesting that the people's attitude towards aircraft noise has changed over the years, and that the EU standard curve for aircraft noise should be modified.	Babisch, Wolfgang, Danny Houthuijs, Göran Pershagen, Ennio Cadum, Klea Katsouyanni, Manolis Velonakis, and Lars Järup. "Annoyance due to aircraft noise has increased over the years—Results of the HYENA study." *Environment International* 35, no. 8 (2009): 1169-1176. (http://www.sciencedirect.com/science/article/pii/S0160412009001615 Accessed January 21, 2013)
S.A. Janssen and H. Vos	A comparison of recent surveys to aircraft noise exposure-response relationships	Technical Report	Not Applicable	Although the models for annoyance and sleep disturbance as a function of exposure measures Lden and Lnight were fitted to the data from a large set of field studies, the validity of the presented relationships depends to a large extent on the validity of the data used. Also, despite the size of the datasets added, the new curves are based on a very limited number of surveys and can therefore only be viewed as very preliminary estimates of updated exposure-response relationships. As such, they are only suitable to use as an indication of the potential increase with respect to earlier curves and not as a replacement of the	A recent analysis on the basis of original survey data **indicated a significant increase over the years in expected annoyance at a given level of aircraft noise exposure. Instead of a gradual increase, annoyance appeared to show an increase from around 1996 onward.** Although several study characteristics were found to be sources of heterogeneity in annoyance response, none of these factors could satisfactorily explain the effect of the year of the study. Another possible explanation for the year effect, the higher rate of expansion of airports in recent years, could neither be confirmed nor ruled out. In line with the absence of indications for a similar increase in annoyance due to other noise sources, no evidence was found for a	Janssen, S.A. and H. Vos,29 April 2009. "A comparison of recent surveys to aircraft noise exposure-response relationships." TNO-034-DTM-2009-01799.

Authors	Title	Design	Threshold Value	Major Findings/Weaknesses	Abstract	Citation
Reference #37				earlier established curves. There are no indications for a similar increase in annoyance for other sources of transportation noise, such as road traffic noise or railway noise, suggesting that a factor that is specific for aircraft noise may be held responsible for the increase. So far, however, no satisfactory explanation has been found. This stresses the need for further research and a further update of the exposure-response relationships for aircraft noise, with more recent aircraft noise study data, collected according to a standardized study design, for instance in a European context.	sensitization to noise of the general population. Although the reasons are not fully understood yet, it appears that one or more factors specific to aircraft noise have changed. The objective of the present study is to quantify the increase in annoyance observed in recent aircraft noise surveys with respect to the exposure response relationship based on older surveys. To this end, the large database used to establish earlier exposure-response relationships on aircraft noise was updated with original data from 7 recent cross-sectional surveys, yielding a total of 27 aircraft noise surveys. Multilevel grouped regression was used to determine the effect estimates of the relationship between exposure and annoyance. Recent original noise survey datasets (1996 and later) were compared to older studies. A significant increase was observed in annoyance at a given level of aircraft noise exposure. Although the possibility of an increase in sleep disturbance has not been addressed in the literature before, a similar increase was found for sleep disturbance on the basis of 11 surveys. The present study, which reflects four decades of aircraft noise annoyance research, yields an estimation of the size of the increase compared to earlier exposure-response relationships for aircraft noise and provides a basis for decisions on whether the exposure-response relationships for aircraft noise need to be updated.	
Henk M.E. Miedema	Annoyance Caused by Environmental Noise Elements for Evidence-Based Noise Policies	Discussion of the findings of multiple research documents	Not applicable	Noise annoyance is a sensitive indicator of adverse noise effects and by itself means that noise affects people's quality of life. For noise annoyance, extensive research has provided relationships that predict the level of noise annoyance that can be expected at a given level of noise exposure. At present, it is possible to calculate maps showing the exposures to noise from aircraft, road traffic, and railways, and with the relationships between exposure and annoyance, these can be translated into estimates of the number of people annoyed. These estimates can be made on the basis of the calculated existing noise exposures, but also, on the basis of scenarios or future noise levels so that the consequences of different scenarios can be explored.	Because effects of environmental noise do not require extremely high or long exposures, they occur, with different degrees of intensity, in a substantial part of the world population, especially in areas with a dense population and dense transportation networks. As a consequence, noise is a global issue that continues to detract from sustainable development. **This article attempts to contribute to evidence-based noise policies by providing a review and systematization of noise-effects modeling and findings. The results presented can be used in noise abatement policy to find the best practical ways of reducing noise-induced effects through the reduction of noise exposure. At present, it is possible to calculate noise maps showing the exposures to noise in residential areas. With the relationships between exposure and effects as presented here, these can be translated into estimates of the number of people affected**. Estimates of effects can	Miedema, Henk M.E. "Annoyance Caused by Environmental Noise: Elements for Evidence-Based Noise Policies." *Journal of Social Issues* 63, no. 1 (2007): 41-57.

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Reference #47					be made on the basis of existing noise exposures, but also on the basis of scenarios for future noise levels, so that the consequences of different scenarios can be explored and decisions with respect to noise abatement measures can be optimized. Such an evidence-based approach may be instrumental in reducing the worldwide burden of environmental noise.	
Wolfgang Babisch Reference #52	Transportation Noise and Cardiovascular Risk: Updated Review and synthesis of epidemiological studies indicate that the evidence has increased	Discussion of the findings of multiple research documents	Not applicable	It provides a critical review of previous studies.	The auditory system is continuously analyzing acoustic information, which is filtered and interpreted by different cortical and sub-cortical brain structures. According to the general stress concept, repeated autonomic and endocrine responses can result in permanent functional and metabolic changes of the organism in chronically exposed subjects. Epidemiological studies suggest a higher risk of cardiovascular diseases, including high blood pressure and myocardial infarction, in subjects chronically exposed to high levels of road or air traffic noise. Sixty-one epidemiological noise studies were evaluated regarding the relationship between transportation noise and cardiovascular outcomes. A meta-analysis was conducted using strict inclusion/exclusion criteria for the studies. As a result, a common risk curve is derived for the relationship between road traffic noise and the incidence of myocardial infarction (MI). Below 60 dB(A) for the road traffic noise level during the day (Lday: 6-22 hr), no notifiable increase in MI risk could be detected. For noise levels greater than 60 dB(A), the MI risk increases continuously, with relative risks (odds ratios) ranging from 1.1 to 1.5 (in reference to ≤60 dB(A)).Using data from the national health statistics and estimates of the "Umweltbundesamt" regarding the traffic noise exposure, population attributable risk percentages are calculated for Germany. According to the results, approx. 4,000 MI cases per year (calculations were made for the year 1999) are attributed to the road traffic noise. If the risk curve is universally applied to all ischaemic heart diseases (IHD), the number would be approx. 27,000 IHD cases per year.	Babisch W. "Transportation noise and cardiovascular risk: Updated Review and synthesis of epidemiological studies indicate that the evidence has increased." Noise Health 2006;8:1-29. (http://www.noiseandhealth.org/text.asp?2006/8/30/1/32464 Accessed January 21, 2013)
Henk M.E. Miedema and Catharian G.M. Oudshoorn Reference #63	Annoyance from Transportation Noise Relationships with Exposure Metrics DNL and DENL and Their	Technical Report	Not applicable	This study presents the correlation equations for annoyance in relation to DNL and DENL	Describes a model of the distribution of noise annoyance with the mean varying as a function of noise exposure. Use of day-night level (DNL) and day-evening-night level (DENL) as noise descriptors; Correlation between DNL and DENL; Presentation of the polynomial approximations of relationship	Miedema, Henk M.E. "Annoyance from Transportation Noise: Relationships with Exposure Metrics DNL and DENL and Their Confidence Intervals." *Environmental Health Perspectives* 109, no. 4 (April 2001): 133.

Authors	Title	Design	Threshold Value	Major Findings/Weaknesses	Abstract	Citation
	Confidence Intervals					
Bernard F. Berry Reference #41	Effect of Noise on Physical Health Risk in London Report on Phase 1 - Review of the Topic	Technical report	Not Applicable	This document provides a review of the evidence presented in relation to potential effects of noise on cardiovascular health.	The potential effects of noise on cardiovascular health have been studied for many years, and possible causal mechanisms, and "models" have been proposed. In this report, the evidence for such effects, and possible "exposure-response relationships" have been reviewed systematically - starting from the basis of a number of previous reviews published between 1998 and 2006 by acknowledged experts in the field – but also including more recent specific research studies. This report forms the basis of the next phase of the project, in which such an exposure-response relationship will be applied to estimate of the numbers of people at cardiovascular and related health risk, from road traffic and airport noise in London.	Berry, Bernard. March 3, 2008. "Effect of Noise on Physical Health Risk in London Report on Phase 1 - Review of the Topic." Berry Environmental Ltd. (BEL) Technical Report. BEL 2008 – 001, Version 2.0.
Bernard F. Berry Reference #42	Effect of Noise on Physical Health Risk in London Report on Phase 2 - Estimates of the Numbers of People at Risk	Technical report	Not Applicable	This report uses risk factors derived from the initial review phase, in the form of Exposure-response relationships, together with available population noise exposure data, to generate estimates of the numbers of people within the GLA area, at risk from Acute Myocardial Infarction AMI, and from Ischaemic Heart Disease IHD, from road and air traffic noise.	Berry Environmental Ltd [BEL] was commissioned, in December 2007, by the Noise Strategy Team at the Greater London Authority [GLA] to: -Provide guidance on the robustness of published cardiovascular risk factors arising from ambient/environmental noise, using the latest available World Health Organisation (WHO) reviews, and other reviews of evidence/criteria, and to suggest best estimates of the factors from the range of published values.- Use derived factors to generate estimates of the numbers of people at cardiovascular and related health risk, from road and air traffic noise, in London, from available population exposure data. BEL Technical Report 2008 -1 [Reference 1] covered the initial review phase of the project. This present Report uses risk factors derived from the initial review phase, in the form of Exposure-response relationships, together with available population noise exposure data, to generate estimates of the numbers of people within the GLA area, at risk from Acute Myocardial Infarction AMI, and from Ischaemic Heart Disease IHD, from road and air traffic noise.	Berry, Bernard. July 15, 2008." Effect of Noise on Physical Health Risk in London Report on Phase 2 - Estimates of the Numbers of People at Risk." Berry Environmental Ltd. (BEL) Technical Report. BEL 2008 – 002.
The Interdepartmental Group on Costs and Benefits Noise Subject Group (IGCB(N))	Noise & Health - Valuing the Human Impacts of Environmental Noise Exposure	Technical Report	Not Applicable	This research surveyed the existing literature and found important evidence linking noise and health impacts, such as annoyance, mental health, cardiovascular and physiological impacts (including acute myocardial infarction and hypertension), hearing impairment, night-time effects (such as increased sleep disturbances, reduced	Not Available	The Interdepartmental Group on Costs and Benefits Noise Subject Group (IGCB(N)). July 2010. "Noise & Health - Valuing the Human Impacts of Environmental Noise Exposure" The Second Report of the IGCB(N). (http://archive.defra.gov.uk/environment/quality/noise/igcb/documents/i

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Reference #27				sleep quality and worsened next-day work performance), and worsened academic performance by schoolchildren. The research also identified a wide range of areas that required further research, which included fundamental research on definitions (such as sleep disturbance), reviewing existing links (including the meta-analysis on hypertension), considering confounding factors (such as air quality and self-selection bias) and practical challenges (including reflecting differing impacts across noise sources).		gcn-noise-health-response100707.pdf Accessed January 21, 2013)
Thu Lan Nguyen, Takashi Yano , Huy Quang Nguyen, Khanh Tuyen Thi Nguyen, Hiroaki Fukushima, Keiji Kawai, Tsuyoshi Nishimurag, Tetsumi Sato Reference #6	Aircraft and road traffic noise annoyance in Da Nang City, Vietnam	Social Survey		The study suggested that Vietnamese appeared to be more disturbed by aircraft noise but less annoyed by road traffic noise than European people. However, the study has also revealed that respondents in Da Nang City had different levels of annoyance than those in Hanoi and Ho Chi Ninh, suggesting that differences in urban form may have affected the reported exposure effects.	It is essential to understand the variation in response among communities towards a standardized noise-control guideline. Socio-acoustic surveys on community response to aircraft and road traffic noises were conducted in residential areas in Da Nang City, a main city in central Vietnam with a small but the third largest airport, to accumulate the data on community response to noise in Vietnam. The ranges of aircraft and road traffic noise exposures observed in Da Nang were from 52 to 64 dB and from 66 to 76 dB Lden, respectively. Representative exposure-response relationship for aircraft and road traffic noise annoyance in Vietnam has been proposed based on data obtained in Hanoi, Ho Chi Minh, and Da Nang City. The close agreement was gained between Da Nang and Ho Chi Minh City's curves which were lower than Hanoi's. The respondents in Da Nang were the most tolerant of noise based on the results of Community Tolerance Level. The background noise level was identified to moderate the difference among the cities. **It has been found that Vietnamese were more disturbed by aircraft noise but less annoyed by road traffic noise than European people.**	Nguyen, Thu Lan, et al. 2012. "Aircraft and road traffic noise annoyance in Da Nang City, Vietnam." Proceedings of InterNoise 2012. Institute of Noise Control Engineering of the USA
Shigenori Yokoshimaa, Takashi Yanob, Makoto Morinagad, Atushi Otae Reference #8	Representative dose-response curves for individual transportation noises in Japan		Not Applicable		Technical subcommittee on Socio-Acoustic Survey Data Archive, which was set up in the Institute of Noise Control Engineering/Japan in 2009 has managed SAS Data Archive (SASDA) since 2011. The SASDA, an archive of data mainly concerning community response to transportation noise in Japan, is constituted of datasets deposited by the committee members and the Ministry of the Environment in Japan. The number of collected data exceeds 20,000 as of December 2011. We compare exposure-	Yokoshimaa, Shigenori. 2012. "Representative dose-response curves for individual transportation noises in Japan." Proceedings of InterNoise 2012. Institute of Noise Control Engineering of the USA.

Authors	Title	Design	Threshold Value	Major Findings/Weaknesses	Abstract	Citation
					response curves among noises from road traffic, conventional railway, Shinkansen railway, civil aircraft, and military aircraft by Self-Defense Force and/or U.S. Military Force. We use LAeq for 24 hours and Ldn as noise metrics. Community response is measured by annoyance due to major specific noise source. Although the number of data on aircraft noise is not enough, military aircraft noise indicates the severest annoyance. The second highest annoyance is civil aircraft noise and Shinkansen Railway noise, followed by conventional railway, road traffic noises. To validate the representativeness of the exposure-response curves, we discuss factors affecting the difference in annoyance.	
H. E. Laszloa, B. F. Berry, P. Abbottc, A. L. Hanselld Reference #9	Environmental noise and cardiovascular disease – observations on a well-known dose-response relationship		Not Applicable	There are limitations to the most widely used exposure-response relationship between transportation noise and myocardial infarction risk established in 2006 by Babisch and used in the 2011 WHO publication "Burden of disease from environmental noise" and in the 2010 European Environment Agency "Good practice guide on noise exposure and potential health effects." In particular, this curve cannot be used to establish a NOAEL/LOAEL. A small number of good quality studies investigating the relationship between environmental noise and CVD risk have been published since then but more studies are needed examining the full range of exposures to better define the exposure-response relationship and investigate the possibility of threshold levels.	There is increasing evidence that environmental noise exposure has a range of impacts on human health and well-being. Following a literature review and meta-analysis, a exposure-response relationship between transportation noise and cardiovascular risk was established in 2006 by Babisch where daytime road traffic noise Lday= 60 dB(A) was the lowest level at which effects were observed. This curve is used in risk estimation. However previous studies have noted that noise related exposure-response curves have several limitations. The aim of this present study is to highlight uncertainties in deriving exposure-response relationships between environmental noise and cardiovascular disease. A review of recent epidemiological studies was conducted, which showed that information about low and high noise doses was lacking. Typically, studies categorised exposure and did not construct exposure-response curves. Thus based on the current evidence, substantial uncertainties exist with respect to the lower limits at which environmental noise might exert impacts on health. Various issues about accuracy of noise exposures estimation at lower levels, study design, study quality and statistics used are further discussed.	Laszloa, H.E., et al. 2012. "Environmental noise and cardiovascular disease – observations on a well-known dose-response relationship." Proceedings of InterNoise 2012. Institute of Noise Control Engineering of the USA.
Civil Aviation Organization (ICAO) Committee on Aviation and Environmental Protection (CAEP)	Assessing Current Scientific Knowledge, Uncertainties and Gaps in Quantifying Climate Change, Noise and Air Quality Aviation	Best Practices	Not applicable	This technical report provides a summary of assessment of metrics and exposure-response curves available for aircraft noise impact analyses. In addition, this report recommends that metrics of DNL and LDEN continue to be used.	Not Available	Maurice L. Q., Lee D. S. (eds) 2009. "Assessing Current Scientific Knowledge, Uncertainties and Gaps in Quantifying Climate Change, Noise and Air Quality Aviation Impacts." Maurice, L. Q,, Lee, D. S., Wuebbles, D. W., Isaksen, I., Finegold, L., Vallet, M., Pilling, M. and Spengler, J. Final Report of the International

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Reference #48	Impacts					Civil Aviation Organization (ICAO) Committee on Aviation and Environmental Protection (CAEP) Workshop, US Federal Aviation Administration and Manchester Metropolitan University, Washington DC and Manchester.
Hong Kong Environment Bureau/ Environmental Protection Department Reference #4	Impact of Air, Noise and Light Pollution on Public Health	Legislative Council Panel Briefing	Not Applicable	Environmental noise may cause annoyance and sleep disturbance. However, there have yet been any concrete international research results showing that environmental noise causes other health problems directly. For example for cardiovascular effects, WHO's overall conclusion is that their associations with noise are weak, although the association is somewhat stronger for ischaemic heart disease than for hypertension. According to WHO, road traffic noise is the main burden of environmental noise in Europe. One in five individuals in Europe has disturbed sleep at night because of traffic noise. On direct health effects, the study could not draw any conclusion that physiological responses due to exposure to a high level of noise are associated with long-term risk of cardiovascular diseases. On noise annoyance and sleep disturbance, the response of the people in Hong Kong is not as strong as compared with that in developed economies. Also, while higher noise exposure would intensify annoyance, various factors like personal sensitivity to noise, satisfaction with the neighbourhood environment etc. would also affect one's perception and response.	This paper informs Members of the Legislative Council Panel on Environmental Affairs, Subcommittee on Issues Relating to Air, Noise and Light Pollution, of the impact of air, noise and light pollution on public health and the associated medical costs in Hong Kong.	Legislative Council Panel on Environmental Affairs Subcommittee on Issues Relating to Air, Noise and Light Pollution, Environment Bureau/Environmental Protection Department, Impact of Air, Noise and Light Pollution on Public Health, CB(1)381/12-13(01), January 2013, (http://www.legco.gov.hk/yr12-13/english/panels/ea/ea_anlp/papers/ea_anlp0111cb1-381-1-e.pdf, accessed 21 January 2013).
Hales Swift	A Review of the Literature Related to Potential Health Effects of Aircraft Noise	Technical Report	Not applicable	This study provides a critical review of research studies evaluating the potential effects of noise. Not all studies on cardiovascular effects have shown significant findings regarding cardiovascular effects, but research shows a pattern of evidence. Sleep and stress as proposed as pathways leading from noise exposure to eventual cardiovascular outcome. There are several potential problems that arise in health studies:- unaccounted for confounding factors;-	Not available	Swift, Hales. July 2010. "A Review of the Literature Related to Potential Health Effects of Aircraft Noise." PARTNER Project 19 Final Report. Report No. PARTNER-COE-2010-003 (http://web.mit.edu/aeroastro/partner/reports/proj19/proj19-healtheffectnoise.pdf Accessed January 21, 2013)

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Reference #29				removal of the impacts of certain factors which are known to be risk factors for cardiovascular disease but might also be outcomes of the noise exposure- inaccurate prediction of exposure to noise sources of interest- difficulties disambiguating impacts of total noise exposure versus exposure to a particular noise source of interest.		
W. Passchier-Vermer and W.F. Passchier Reference #56	Environmental Noise, Annoyance, and Sleep Disturbance	Critical Review	Not applicable	This document presents a summary table indicating long-term effects of exposure to environmental noise, and information on their observation threshold. Exposure-response relationship equations for annoyance. Exposure-response relationship equations for sleep disturbance. The exposure-response relationships show that people start to be highly annoyed at Lden over 55 dB(A) and report to be highly sleep disturbed at Lnight lower than 45 dB(A).	A rough estimate of the number of people in the EU exposed to environmental noise (from road traffic, railway traffic and aircraft) above a day-evening-night-level of 55 dB(A) is 150 million (40 per cent), including about 120 million people exposed to road traffic noise. Adverse environmental noise-induced health effects mainly are annoyance, sleep disturbance, stress-related somatic effects, effects on learning in children, and possibly hearing damage. These effects occur in a substantial part of the EU population. In this chapter the relationships between annoyance and noise exposure to various types of environmental noise are given. With respect to sleep disturbance, this chapter discusses effects of night time noise on motility (motoric unrest), self-reported sleep disturbance, and self-assessed awakening.	Passchier-Vermer, W. and W.F. Passchier, Environmental Noise, Annoyance, and Sleep Disturbance. Environmental Health Impacts of Transport and Mobility (Environmental Science and Technology Library Vol. 21), pp. 25-38, P. Nicolopoulou-Stamati et al. (eds), © 2005 Springer. Printed in the Netherlands.
Y. Aydin and M. Kaltenbach Reference #49	Noise Perception, Heart Rate, and Blood Pressure in Relation to Aircraft Noise in the Vicinity of the Frankfurt Airport	Residential areas were selected with air traffic noise being the predominant source of noise. Average noise levels were taken from official maps edited by the Hessian environmental office. Two areas were selected: one West and one East of the airport, both with nocturnal aircraft noise levels of Leq(3)=50 dB(A) outside. This level was present during direction 25 in the West and during direction 07 in the East. In contrast, during direction 07 the West area was exposed to Leq(3)=40 dB(A) and during direction 25 the East area to Leq(3)=40 dB(A) only. Daytime noise levels in both areas were about 5 dB(A) higher than night time noise levels, with similar differences between the two flight directions. In both areas noise was predominantly created by planes taking off.	Nocturnal aircraft noise levels of Leq(3)=50 dB(A) outside	This study proves that in residential areas with a nocturnal equivalent continuous aircraft noise levels of between 40 and 50 dB(A) outside, depending on air traffic direction (and a daily aircraft noise level between about 45 and 55 dB(A) outside depending on traffic directions), changes in perception of noise and in blood pressure occur parallel to changing levels of aircraft noise. Depending on the frequency and duration of the noise, alterations in subjective noise perception and in objective circulatory parameters were documented parallel to the changes in average aircraft noise levels. The present study revealed pathological changes of noise perception and blood pressure occurring with 50 dB(A) compared to 40 dB(A). Thus a nocturnal equivalent continuous aircraft noise level of 50 dB(A) outside can produce disturbances in noise perception and the circulatory system. To avoid alterations in health, the amount of	The aim of this study was to evaluate subjective noise perception and objective parameters of circulation in the vicinity of the Frankfurt airport. Two areas were selected in which aircraft noise was the predominant source of noise (and was) created by planes induced by takeoff but not during landing. Data of residents living in the two areas were observed over a period of twelve weeks, one area being exposed to air traffic noise for three quarters of the given time, the other for one quarter of the time. Methods Fifty three volunteers (age 50–52±15 y) monitored their blood pressure and heart rate over a period of three months by using an automatic device with digitized readings. They also protocolled their own subjective perception of noise and sleep quality. Thirty one probands were living West of the airport (West group) and were exposed to a nocturnal equivalent continuous air traffic noise level of Leq(3)=50 dB(A) outside, during flight direction 25 to the West. Twenty two probands were living East of the airport (East group) and were exposed to Leq(3)=50 dB(A) during flight direction 07 to the East. During the opposite flight directions air craft noise corresponded to Leq(3)=40	Aydin, Y. and M. Kaltenbach, 2007. “Noise perception, heart rate and blood pressure in relation to aircraft noise in the vicinity of the Frankfurt airport.” Clinical Research in Cardiology, Volume 96, Number 6: 347–358.

Authors	Title	Design	Threshold Value	Major Findings/Weaknesses	Abstract	Citation
				tolerable noise levels has to be kept markedly below this level.	dB(A) in both areas. Frankfurt airport operates direction 25 for about 75%of the time on average and direction 07 for 25% of the time. Results The average blood pressure was significantly higher in the West group with higher noise exposure. Morning systolic blood pressure was 10 mmHg and diastolic pressure 8 mmHg higher in the West group. Throughout the observation period, the East group showed a parallel between daily changes in noise and subjective noise perception. In the West group such a parallel did not appear. This reaction was considered to be the consequence of the high noise exposure of the West group. Conclusion It is concluded that a population exposed to a nocturnal equivalent continuous air traffic noise level of Leq(3)=50 dB(A) for three quarters of a given time has a higher average blood pressure compared to a population exposed to the same equal energy noise level for only one quarter of the time. Within the East group a parallel between noise exposure and noise perception was observed, while in the West group this parallel did not appear. The difference is considered to be the consequence of higher noise stress levels in the West group. The data are in accordance with recent epidemiological studies and indicate that a nocturnal aircraft noise of Leq(3) = 50 dB(A) can have negative effects on subjective noise perception and on objective parameters of circulation.	
W. Babisch Reference #60	Traffic, Noise, and Health	Book chapter	Not applicable	No studies are available of data that provide a quantitative dose response relationship between aircraft noise and cardiovascular endpoints. Suspicion exists that the effects induced by aircraft noise could be greater than those induced by road traffic.	Traffic noise causes a lot of concern in the population. It annoys, disturbs sleep and can cause cardiovascular problems in chronically noise-exposed subjects. Approximately 50 million people in the European community are exposed to sound levels from road traffic at home, that are suspected of increasing the risk of cardiovascular disorders. The noise effects hypothesis is based on the general stress model. The mechanism includes arousal of the sympathetic and endocrine system. Heart rate, blood pressure, stress hormones and classical biological risk factors of ischaemic heart disease (IHD) are affected by the noise. In epidemiological studies, subjects who live in noise exposed areas show a higher prevalence of high blood pressure and IHD (including myocardial infarction). It is estimated that approximately 3 per cent of IHD cases in the general population may be attributed to traffic noise.	Babisch, W., "Traffic Noise and Health." Environmental Health Impacts of Transport and Mobility (Environmental Science and Technology Library Vol. 21), pp. 9-24. P. Nicolopoulou-Stamati et al. (Eds), © 2005 Springer. Printed in the Netherlands.

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World Health Organization Reference #34	Night Noise Guidelines for Europe	Best Practices	Not applicable	The purpose of this document is to present the conclusions of the WHO working group responsible for preparing guidelines for exposure to noise during sleep. This guidelines document reviews the health effects of night time noise exposure, examines exposure-response relations, and presents guideline values of night noise exposure to prevent harmful effects of night noise in Europe.	The WHO Regional Office for Europe set up a working group of experts to provide scientific advice to the Member States for the development of future legislation and policy action in the area of assessment and control of night noise exposure. The working group reviewed available scientific evidence on the health effects of night noise, and derived health-based guideline values. In December 2006, the working group and stakeholders from industry, government and nongovernmental organizations reviewed and reached general agreement on the guideline values and key texts for the final document of the Night noise guidelines for Europe. Considering the scientific evidence on the thresholds of night noise exposure indicated by Lnight, outside as defined in the Environmental Noise Directive (2002/49/EC), an Lnight, outside of40 dB should be the target of the night noise guideline (NNG) to protect the public, including the most vulnerable groups such as children, the chronically ill and the elderly. Lnight, outside value of 55 dB is recommended as an interim target for the countries where the NNG cannot be achieved in the short term for various reasons, and where policy-makers choose to adopt a step wise approach. These guidelines are applicable to the Member States of the European Region, and may be considered as an extension to, as well as an update of, the previous WHO Guidelines for community noise (1999).	World Health Organization, 2009. "Night noise guidelines for Europe." Copenhagen, WHO Regional Office for Europe. (http://www.euro.who.int/__data/assets/pdf_file/0017/43316/E92845.pdf, accessed 21 January 2013).
Wolfgang Babisch, Irene van Kamp Reference #36	Exposure-response relationship of the association between aircraft noise and the risk of hypertension	Technical Report	Not applicable	There is sufficient **qualitative** evidence that aircraft noise increases the risk of hypertension in adults. This article establishes a "best guess" estimate for quantitative risk assessment of cardiovascular risk from aircraft noise.	Noise is a stressor that affects the autonomic nervous system and the endocrine system. **Under conditions of chronic noise stress the cardiovascular system may adversely be affected**. **Epidemiological noise studies regarding the relationship between aircraft noise and cardiovascular effects have been carried out on adults and on children focusing on mean blood pressure, hypertension and ischemic heart diseases as cardiovascular endpoints.** While there is evidence that road traffic noise increases the risk of ischemic heart disease, including myocardial infarction, **there is less such evidence for such an association with aircraft noise. This is partly due to the fact that large scale clinical studies are missing**. **There is sufficient qualitative evidence, however, that aircraft noise increases the risk of hypertension in adults. Regarding aircraft noise and children's blood pressure the results are**	Babisch, Wolfgang, and Irene Van Kamp. "Exposure-response relationship of the association between aircraft noise and the risk of hypertension." *Noise & Health* 11, no. 44 (2009): 161-168.

Authors	Title	Design	Threshold Value	Major Findings/Weaknesses	Abstract	Citation
					still inconsistent. The available literature was evaluated for the WHO working group on "Aircraft Noise and Health" based on the experts' comprehensive knowledge in this field. With respect to the needs of a quantitative risk assessment for burden of disease calculations an attempt was made to derive an exposure-response relationship based on a meta-analysis. This association must be viewed as preliminary due to limitations which are concerned with the pooling of studies due to methodological differences in the assessment of exposure and outcome between studies. More studies are needed to establish better estimates of the risk.	
Lars Jarup, Wolfgang Babisch, Danny Houthuijs, Göran Pershagen, Klea Katsouyanni, Ennio Cadum, Marie-Louise Dudley, Pauline Savigny, Ingeburg Seiffert, Wim Swart, Oscar Breugelmans, Gösta Bluhm, Jenny Selander, Alexandros Haralabidis, Konstantina Dimakopoulou, Panayota Sourtzi, Manolis Velonakis, and Federica Vigna-Taglianti, on behalf of the HYENA study team. Reference #43	Hypertension and Exposure to Noise Near Airports the HYENA Study			This study found significant exposure-response relationships between night-time aircraft as well as average daily road traffic noise exposure and risk of hypertension after adjustment for major confounders. For night-time aircraft noise, a 10-dB increase in exposure was associated with an odds ratio (OR) of 1.14 [95% confidence interval (CI), 1.01-1.29]. The exposure-response relationships were similar for road traffic noise and stronger for men with an OR of 1.54 (95% CI, 0.99-2.40) in the highest exposure category (> 65 dB; ptrend = 0.008).	An increasing number of people are exposed to aircraft and road traffic noise. Hypertension is an important risk factor for cardiovascular disease, and even a small contribution in risk from environmental factors may have a major impact on public health. OBJECTIVES: The HYENA (Hypertension and Exposure to Noise near Airports) study aimed to assess the relations between noise from aircraft or road traffic near airports and the risk of hypertension. METHODS: We measured blood pressure and collected data on health, socioeconomic, and lifestyle factors, including diet and physical activity, via questionnaire at home visits for 4,861 persons 45-70 years of age, who had lived at least 5 years near any of six major European airports. We assessed noise exposure using detailed models with a resolution of 1 dB (5 dB for United Kingdom road traffic noise), and a spatial resolution of 250 × 250 m for aircraft and 10 × 10 m for road traffic noise. RESULTS: We found significant exposure-response relationships between night-time aircraft as well as average daily road traffic noise exposure and risk of hypertension after adjustment for major confounders. For night-time aircraft noise, a 10-dB increase in exposure was associated with an odds ratio (OR) of 1.14 [95% confidence interval (CI), 1.01-1.29]. The exposure-response relationships were similar for road traffic noise and stronger for men with an OR of 1.54 (95% CI, 0.99-2.40) in the highest exposure category (> 65 dB; ptrend = 0.008). CONCLUSIONS: Our results indicate excess risks of hypertension related to long-term noise exposure, primarily for night-time aircraft noise and daily average road traffic noise.	Jarup, Lars, Wolfgang Babisch, Danny Houthuijs, Göran Pershagen, Klea Katsouyanni, Ennio Cadum, and Federica Vigna-Taglianti. "Hypertension and Exposure to Noise Near Airports: the HYENA Study." *Environmental Health Perspectives* 116, no. 3 (2008): 329-333.

Authors	Title	Design	Threshold Value	Major Findings/Weaknesses	Abstract	Citation
Mathias Basner Reference #45	Nocturnal aircraft noise exposure increases objectively assessed daytime sleepiness	The study protocol was approved by the ethics commission of the Medical Board of the district North Rhine. In each of 16 study phases, 8 subjects were investigated simultaneously. They slept in separate bedrooms in the underground sleep facility of the DLR-Institute of Aerospace Medicine for 13 consecutive nights. Night 1 served as adaptation, night 2 as baseline, and nights 12 and 13 as recovery. These nights were noise-free. During nights 3–11, aircraft noise events (ANEs) with maximum sound pressure levels (SPLs) of 45, 50, 55, 60, 65, 70, 75, or 80 dB(A) from either starting or approaching aircraft were played back via loudspeakers. As there were 30 exposure patterns but only nine exposure nights per study phase, the study had a randomized incomplete block design.	Not Applicable	This is the first study to show that nocturnal aircraft noise exposure increases objectively assessed sleepiness in the next morning. The results could be included qualitatively in HIA.	There is no doubt that noise in general and aircraft noise specifically disturb sleep. However, so far no study has objectively assessed the effects of traffic noise on daytime sleepiness. In a polysomnographic laboratory study, 24 subjects (mean ± SD age 33.9 ± 10.8 years, 12 male) were investigated between 7:30 am and 8:30 am with infrared pupillography after a noise-free baseline night and after 9 nights with varying degrees of aircraft noise exposure. The natural logarithm of the pupillary unrest index (lnPUI) differed significantly (p = 0.006) between noise (lnPUI = 1.61) and baseline (lnPUI = 1.48) nights. Objective sleepiness levels increased significantly with the number of noise events (p = 0.021), with the maximum sound level of noise events (p = 0.028), and with the equivalent continuous noise level (p = 0.013) in exposure nights. However, these levels did not reach pathological levels as observed in another study on untreated obstructive sleep apnea patients. This is the first study to show that nocturnal aircraft noise exposure increases objectively assessed sleepiness in the next morning. These findings stress the relevance and the potential public health impact of sleep disturbances induced by environmental noise. Further studies are needed to investigate the association of nocturnal traffic noise exposure and objectively assessed sleepiness in the field.	Basner, Mathias. "Nocturnal aircraft noise exposure increases objectively assessed daytime sleepiness." *Somnologie* 12, no. 2: (2008): 110-117.
S A Stansfeld, B Berglund, C Clark, I Lopez-Barrio, P Fischer, E Öhrström, MMHaines, J Head, S Hygge, I van Kamp, B F Berry, on behalf of the RANCH study team Reference #55	Aircraft and road traffic noise and children's cognition and a cross-national study	Cross-national study		Findings indicate that a chronic environmental stressor—aircraft noise—could impair cognitive development in children, specifically reading comprehension. Schools exposed to high levels of aircraft noise are not healthy educational environments.	Summary Background Exposure to environmental stressors can impair children's health and their cognitive development. The effects of air pollution, lead, and chemicals have been studied, but there has been less emphasis on the effects of noise. Our aim, therefore, was to assess the effect of exposure to aircraft and road traffic noise on cognitive performance and health in children. Methods We did a cross-national, cross-sectional study in which we assessed 2844 of 3207 children aged 9-10 years who were attending 89 schools of 77 approached in the Netherlands, 27 in Spain, and 30 in the UK located in local authority areas around three major airports. We selected children by extent of exposure to external aircraft and road traffic noise at school as predicted from noise contour maps, modelling, and on-site measurements, and matched schools within countries for socioeconomic status. We measured cognitive and health outcomes with standardised tests and questionnaires administered in the classroom. We also used	Stansfeld, SA, B Berglund, C Clark, I Lopez-Barrio, P Fischer, Eohrstrom, and BF Berry. "Aircraft and road traffic noise and children's cognition and health: a cross-national study." Lancet 365, no. 9475 (2005): 1942-1949.

Authors	Title	Design	Threshold Value	Major Findings/Weaknesses	Abstract	Citation
					a questionnaire to obtain information from parents about socioeconomic status, their education, and ethnic origin. Findings We identified linear exposure-response associations between exposure to chronic aircraft noise and impairment of reading comprehension (p=0·0097) and recognition memory (p=0·0141), and a non-linear association with annoyance (p<0·0001) maintained after adjustment for mother's education, socioeconomic status, longstanding illness, and extent of classroom insulation against noise. Exposure to road traffic noise was linearly associated with increases in episodic memory (conceptual recall: p=0·0066; information recall: p=0·0489), but also with annoyance (p=0·0047). Neither aircraft noise nor traffic noise affected sustained attention, self-reported health, or overall mental health. Interpretation Our findings indicate that a chronic environmental stressor-aircraft noise-could impair cognitive development in children, specifically reading comprehension. Schools exposed to high levels of aircraft noise are not healthy educational environments.	
Bernard F Berry, Ian H Flindell Reference #35	Estimating Dose-Response Relationships Between Noise Exposure And Human Health Impacts In the UK	Technical Report	Not applicable	It was found that while evidence exists on the link between noise and all the considered health impacts the primary focus of further work should be on Cardiovascular effects, but that Sleep disturbance [awakenings] should also be considered in more detail. It is concluded that the exposure-response relationship proposed by Babisch in 2006 between Lday and Myocardial infarction provides an adequate basis for a methodology to value health effects. There appears to be no exposure-response relationship that sufficiently meets all the criteria for a robust exposure-response relationship for noise induced sleep disturbance applicable for a methodology to value health effects.	Currently, health effects from various pollutants are controlled primarily through the use of limit values and with regard to noise, this principle can be found in the Control of Noise at Work Regulations. Other advice can be found in World Health Organisation guideline values, but for noise, some of these tend to focus on the level of exposure below which there is no adverse effect expected. Consequently, the health effects of noise are not fully taken into account in the appraisal of policy. One way to improve the situation would be to explore whether it is possible to define robust exposure-response functions to translate noise exposure into health end points. This research aims to address this gap in the methodology and ultimately enable IGCB (N) to develop a framework which could be used for valuing the health impacts of noise in the UK. The main aims of this project were: (1) to identify the potential adverse health impacts and review the current state of evidence for each of the impacts; and (2) where a robust evidence base exists, to develop robust exposure-response functions for the impacts of noise and health which could be applied to policy appraisal in the UK.	Berry, Bernard and Ian H. Flindell, July 2009. BEL Technical Report BEL 2009 - 002. (http://archive.defra.gov.uk/environment/quality/noise/igcb/documents/tech-report.pdf Accessed January 21, 2013)

Authors	Title	Design	Threshold Value	Major Findings/Weaknesses	Abstract	Citation
Hong Kong Environmental Protection Department Tender No. NP03-055 Reference #46	Additional Work for A Comparative Study of Noise Levels in Hong Kong	Technical Report	Not applicable	This Report provided a summary of findings of non-auditory health effects caused by environmental noise. Annoyance and sleep disturbance were shown to be positively associated with noise exposure. Findings for other adverse health effects were inconclusive.	Not available	Scott Wilson Ltd. November 2007. "Additional Work for A Comparative Study of Noise Levels in Hong Kong." prepared for the Hong Kong Environmental Protection Department under Tender No. NP03-055. (http://www.epd.gov.hk/epd/english/environmentinhk/noise/studyrpts/files/2012.12.06_03.pdf accessed January 21. 2013)
Centre for Environmental Policy and Resource Management of the Chinese University of Hong Kong Reference #7	The Provision of Service For the Study of Health Effects of Transportation Noise in Hong Kong	A household survey was conducted territory-wide to obtain necessary information on human annoyance and sleep disturbance due to transportation noise of the population of Hong Kong.		The study has ascertained that road traffic noise is a problem with possible health effects in HK. The estimates obtained in this study are reliable, and findings sound because of the scientific rigor in questionnaire design and sampling.	Kong Special Administrative Region, this study investigates the health effects of transportation noise in Hong Kong. Among the various effects of noise, WHO highlighted annoyance, sleep disturbance and cardiovascular disease. This is the first systematic city-wide study in Hong Kong and one of the few in the world using the ISO/TS 15666 protocol on survey methodology. The study attempts to identify the key health effects of transportation noise by reviewing the recent scientific literature and undertaking a large scale survey of the Hong Kong population using carefully thought out sampling strategy and interview technique. This study was supported by a separate noise mapping exercise assessing the noise exposure levels of the whole city and a social survey implemented by the Census and Survey Department of the Government of the Hong Kong Special Administrative Region as part of their "thematic survey" studies. A total of 10,077 households were successfully interviewed and noise exposure level assessed. This study team designed the questionnaire and trained the interviewers of the social survey.	Hong Kong Environmental Protection Department Tender Ref. AN 08-047. January 2012.(http://www.epd.gov.hk/epd/english/environmentinhk/noise/studyrpts/files/study_health_effects.pdf Accessed January 21, 2013)
Rokho Kim, Martin van den Berg Reference #30	Summary of night noise guidelines for Europe	Summary	Not applicable	Provides a table showing the effects of different levels of night noise on the population's health.	Considering the scientific evidence on the threshold of night noise exposure indicated by Lnight as defined in the Environmental Noise Directive (2002/49/EC), Lnight value of 40 dB should be the target of the night noise guideline (NNG) to protect the public, including the most vulnerable groups such as children, the chronically ill and the elderly. Lnight value of 55 dB is recommended as an interim target for countries which cannot follow NNG in the short term for various reasons and where policy-makers choose to adopt a stepwise approach. These guidelines may be considered an extension to the previous World Health Organization (WHO) guidelines for community noise (1999).	Rokho, Kim, and Martin Van den Berg. "Summary of night noise guidelines for Europe." Noise & Health 12, no. 47 (2010): 61-63.

Authors	Title	Design	Threshold Value	Major Findings/Weaknesses	Abstract	Citation
Anke Huss, Adrian Spoerri, Matthias Egger, and Martin Röösli for the Swiss Nathional Cohort Study Group Reference #22	Aircraft Noise, Air Pollution, and Mortality from Myocardial Infarction	Technical Report	□60 dB(A) < 45 dB(A)	Exposure to noise levels equal to or above 60 dB leads to increase risk of mortality by myocardial infarction, particularly if duration of 10 to 15 years. Study mentions that the closer one resides to an airport usually indicates lower education, higher unemployment, more foreign nationals, and in many instances older housing, but the Study rejects these variables.	This document presents the results of a recent (2010) analysis of population and mortality data in Switzerland to determine if there is a linkage between the exposure to aircraft and roadway noise and air pollution to the incidence of myocardial infarction.	Anke Huss, Adrian Spoerri, Matthias Egger, and Martin Röösli for the Swiss Nathional Cohort Study Group. "Aircraft Noise, Air Pollution, and Mortality from Myocardial Infarction." Epidemiology, Volume 21, Number 6, November 2010.
Moniek Zuurbier, Christofer Lundqvist, Georfes Salines, Stephen Stansfeld, Wojciech Hanke, Wolfgang Babisch, Marie Louise Bistrup, Peter Van Den Hazel and Hanns Moshammer Reference #50	The Environmental Health of Children: Priorities in Europe	Technical Report	Not applicable	The Policy Interpretation Network on Children's Health and Environment (PINCHE) evaluate existing researches on the environmental health of children and provide a prioritized list of risk factors and policy recommendations for action. The report concluded that some of the noise sources were classified as medium priority.	The project focused on air pollutants, carcinogens, neurotoxicants and noise. Information related to exposure, epidemiology, and toxicology was analysed separately and then a risk evaluation of particular environmental factors was made. Socioeconomic factors were specifically taken into account. PINCHE concluded that some noise sources were classified as being of medium priority. This priority list must be continuously revised, the precautionary principle should be central to all decisions, and the focus should be on safe exposure levels for children.	M. Zuurbuier et al., 2007 "Environmental health of Children: Priorities in Europe" international Journal of Occupational Medicine and Environmental Health 2007; 20(3); 291-308
An Independent Commission Appointed by Government Reference #5	Discussion Paper 05: Aviation Noise	Discussion Paper	Not applicable		Provides a review of existing literature and research on airport noise , and attempts to open up a number of key issues for debate.	www.gov.uk/government/organisations/airports-commission, Discussion Paper 05: Aviation Noise, July 2013
Clark, Charlotte et al (2009). Reference #39	RANCH Follow-Up Study: The Long –Term Effects of Aircraft Noise Exposure on Children's Cognition	ESRC Research Report	Not applicable	The results are not finalized, and the research results have not been used or applied outside this study.	A follow up study of the UK sample of the RANCH cohort examining the long-term effects of aircraft noise exposure at primary school on children's' reading.	Clark, Charlotte et al (2009). Ranch follow-up study: the long-term effects of aircraft noise exposure on children's cognition: Full Research Report ESRC End of Award Report, RESSS-062-23-1165. Swindon: ESRC.
UCLA CHAT PGY-2 Pediatric Residents Reference #32	Santa Monica Airport Health Impact Assessment	Technical Report		Levels of noise due to aircraft operations are above FAA thresholds; Excessive noise is associated with hearing loss, higher levels of psychological distress, and impaired reading comprehension among children	A health directed summary of the issues facing the community near the Santa Monica Airport	Castro, Adrian et al (2010). Santa Monica Airport Health Impact Assessment (HIA). February 2010.
Janssen, Sabine A., and Vos, Henk Reference #21	Dose-response relationship between DNL and Aircraft Noise Annoyance: Contribution of TNO	Technical Report	Not Applicable		Overview of the state of the exposure-response relationships for aircraft noise annoyance, including evidence on factors that may influence annoyance in addition to energy equivalent noise metrics, such as increased annoyance due to exposure to aircraft noise over time.	Janssen, Sabine A. and Vos, Henk. Dose-response relationship between DNL and Aircraft Noise Annoyance: Contribution of TNO. TNO-06-UT-2011-00207. May 2011.

Authors	Title	Design	Threshold Value	Major Findings/Weaknesses	Abstract	Citation
Abrahams, Debbie et al Reference #44	A Rapid Health Impact Assessment of Birmingham International Airport's Proposed Runway Extension	Technical Study			The HIA attempts to inform and influence policy decision making by enabling the decision makers to consider the health implications of their policies during the planning process.	Abrahams, Debbie et al. A Rapid Health Impact Assessment of Birmingham International Airport's Proposed Runway Extension. The International Health Impact Assessment Consortium. February 2008.
Buroni, Andrew and Smyth, Daniel Reference #51	London City Airport Interim Application Health Impact Assessment	Technical Study	Not applicable		In keeping with best practice and LCY's ongoing pledge to be a responsible member of the community, LCY voluntarily commissioned an EIA alongside a Sustainability Appraisal and Carbon Analysis Report, and a Health Impact Assessment (HIA) to investigate and further reduce the impact of Airport activities on local communities.	Buroni, Andrew and Smyth, Daniel. London City Airport Interim Application Health Impact Assessment. July 2007.
Aziz, Dr. Muna I. Abdel et al Reference #65	Health Impact Assessment, Finningley Airport	Technical Study			An HIA for the proposed Finningley airport to assist those responsible for planning decisions to maximize health benefits of any proposed development and to minimize any negative impacts.	Aziz, Dr. Muna I. Abdel et al. Health Impact Assessment, Finningley Airport. Doncaster Health Authority. September 2000.
Anna Hansel and Marta Blangiardo, et al. Reference #2	Aircraft Noise and Cardiovascular Disease Near Heathrow Airport in London: Small Area Study	Technical Study	Not applicable	Results suggest high levels of aircraft noise are associated with increased risk of stroke, coronary heart disease, and cardiovascular disease. A weakness with this study is that the possibility of causal and alternative explanations were not fully considered. This study did not have access to individual level confounder data such as smoking and ethnicity.	This study investigated the risks of stroke, coronary heart disease, and cardiovascular disease hospital admissions and mortality in areas exposed to aircraft noise near Heathrow airport. The study area comprised 12 London boroughs and nine districts west of London exposed to aircraft noise defined as being partly or wholly within the 2001 50 dB noise contour for Heathrow aircraft during daytime. Hospital admissions data for the study area for the period 2001-2005 were collected for stroke, coronary heart disease, and cardiovascular disease then linked to census data for the study area.	Hansell, Anna L., 2013. "Aircraft Noise and Cardiovascular Disease Near Heathrow Airport in London: Small Area Study" British Medical Journal. 2013;347:DOI:10.1136/bmj.f5432
Andrew W. Correia, Jonathan I. Levy, Steven Melly, and Francesca Dominici Reference # 3	Residential Exposure to Aircraft Noise and Hospital Admissions for Cardiovascular Diseases: Multi-Airport Retrospective Study	Technical Study	Not Applicable	As noted by the authors, the Medicare database was developed for administrative purposes and has been shown to be subject to misclassification and geographic variability in evaluation and management. Because of data uncertainties and limitations identified by the researchers and the inability to control for all contributing factors, the results of this study are too preliminary to be the basis for policy decisions relating to aviation noise.	This study examined the possible link between aviation noise and increased risk of hospitalization for cardiovascular disease of Medicare patients living near 89 US airports. The study population (6,027,363 people aged 65 and older residing in the 2218 zip codes and close to 89 US airports) corresponded to approximately 15% of the US population of older people. The study found that aircraft noise, particularly characterized by the 90th centile of noise exposure among census blocks within the 2218 zip code, is statistically significantly associated with higher relative rate of hospitalization for cardiovascular disease among older people living near airports.	Hansell AH, Blangiardo M, Fortunato L, *et al*. Aircraft noise and cardiovascular disease near Heathrow airport in London: Small area study. *BMJ* 2013; 347: DOI:10.1136/bmj.f5432.

Authors	Title	Design	Threshold Value	Major Findings/Weaknesses	Abstract	Citation
Jurgita Lekaviciute, Stlianos Kephalopoulos, Stephen Stansfeld, Charlotte Clark Reference #1	ENNAH – European Network on Noise and Health, Final Report	ENNAH Research Report and Guidance (Scientific and Policy nature)	Not Applicable	This study focused on outlining new priorities and recommendations for research on the negative effects of environmental noise on health, and to encourage new research testing the effectiveness of noise reduction policies. ENNAH establishes an extensive research network of experts on noise and health in Europe (including 33 European research centres from 16 countries). Particularly, Work Package (WP) 2 carried out literature search with critical review for 145 papers between 1980 and end 2012. The WP2 specifically pointed out that WHO showed clear linkages between environmental noise with sleep disturbance and annoyance, whilst limited evidence for cardiovascular diseases and hypertension, but different views from EEA. Moreover, an expert survey amongst 25 ENNAH partners was also conducted in WP2 on strength of evidence for various health outcomes against transportation noise sources. Majority agreed sufficient evidence for annoyance and sleep disturbance, whilst 50/50 for cardiovascular diseases and hypertension and relative doubt for cognitive performance.	The European Commission's Joint Research Centre ENNAH Project (The European Network on Noise and Health) brought together 33 European research centres to establish future research directions and policy needs for noise and health, focusing particularly on transportation noise. The ENNAH report identified gaps in noise and health research and assessed and prioritized future research needs into policy development for more efficient use of resources for further research and improvement of assessment methodologies.	Joint Research Centre of the European Commission 2013. "ENNAH – European Network on Noise and Health, Final Report." Final Report FP7-ENV-2008-1, no. 226442. http://www.ennah.eu/assets/files/ENNAH-Final_report_online_19_3_2013.pdf. Accessed November 14, 2013.
Martin Kaltenbach, Christian Maschke, Rainer Klinke Reference #41	Health Consequences of Aircraft Noise	Literature Review	60dB daytime and 50dB nighttime for health grounds	By limiting the exposure to aircraft noise to equivalent levels below 60dB during daytime and 50dB at night could be avoiding impairment of health based on extensively review for a number of sizeable epidemiological studies (over case numbers of above 1,000 or more than 5,000 individual measured values in the case of time-series studies)	**Introduction:** The ever-increasing level of air traffic means that any medical evaluation of its effects must be based on recent data. Methods: Selective literature review of epidemiological studies from 2000 to 2007 regarding the illnesses, annoyance, and learning disorders resulting from aircraft noise. **Results:** In residential areas, outdoor aircraft noise-induced equivalent noise levels of 60 dB(A) in the daytime and 45 dB(A) at night are associated with an increased incidence of hypertension. There is a dose-response relationship between aircraft noise and the occurrence of arterial hypertension. The prescription frequency of blood pressure lowering medications is associated dose-dependently with aircraft noise from a level of about 45 dB(A). Around 25% of the population are greatly annoyed by exposure	Kaltenbach, M., et al. (2008). Health Consequences of Aircraft Noise. Dtsch Arztebl Int 2008: 105(31-32).

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					to noise of 55 dB(A) during the daytime. Exposure to 50 dB(A) in the daytime (outside) is associated with relevant learning difficulties in schoolchildren. **Discussion:** Based on recent epidemiological studies, outdoor noise limits of 60 dB(A) in the daytime and 50 dB(A) at night can be recommended on grounds of health protection. Hence, maximum values of 55 dB(A) for the day and 45 dB(A) for the night should be aimed for in order to protect the more sensitive segments of the population such as children, the elderly, and the chronically ill. These values are 5 to10 dB(A) lower than those specified by the German federal law on aircraft noise and in the report "synopsis" commissioned by the company that runs Frankfurt airport (Fraport).	
Heidemarie Wende, Jens Ortscheid Reference #64	Requirements for the protection against aircraft noise	Guidelines	60dB daytime and 50dB nighttime for health grounds	• Avoiding of considerable nuisance by limiting the exposure to aircraft noise (outside) to equivalent levels below 55 dB(A) by day and 45 dB(A) at night; • Avoiding of impairment of health by limiting the exposure to aircraft noise (outside) to equivalent levels below 60 dB(A) by day and 50 dB(A) at night.	In preparation of the revised edition of the Air Traffic Noise Act the Federal Environmental Agency formulated targets for aircraft noise control. They were prepared oriented to the Federal Immission Control Act. The assessment periods were chosen analogously to the regulations on other traffic noise sources (rail traffic, road traffic). The control targets cover the following affected areas • aural, extra-aural health • night's sleep • annoyance • communication • recreation. Considerable nuisance can be avoided by limiting the exposure to aircraft noise (outside) to equivalent levels below 55 dB(A) by day and 45 dB(A) at night, and impairment of health can be avoided by limiting the exposure to aircraft noise (outside) to equivalent levels below 60 dB(A) by day and 50 dB(A) at night.	Federal Environmental Agency Berlin. (2004). Requirements for the Protection Against Aircraft Noise.
Wyle Acoustics Group Reference #65	Land Use Planning Guidelines for New Non-Urban Airports	Technical Report	A range of criteria in different jurisdictions	Annoyance noise level criteria: EPA Level Document: DNL55 US FAA: DNL65 Transport Canada: NEF(CDN)30 WHO: Leq16 55dB	N/A	Wyle Acoustics Group (2004). Land Use Planning Guidelines for New Non-Urban Airports.