

## Environmental Noise Pollution Control

**Date:** Nov 05 2013 | **Policy Number:** 20135

**Key Words:** Environmental Health, Pollution, Research, Environmental Protection Agency

Related APHA policy statements

APHA Policy Statement 7522 – APHA Policy Statement on Noise

APHA Policy Statement 6818 – Noise

APHA Policy Statement 6407 – Noise Abatement

APHA Policy Statement 20125 – The Environmental and Occupational Health Impacts of High-Volume Hydraulic Fracturing of Unconventional Gas Reserves

APHA Policy Statement 20105 – Prioritizing Cleanup of the Hanford Nuclear Reservation to Protect the Public's Health

APHA Policy Statement 8221 – Occupational Safety and Health Administration Priorities

APHA Policy Statement 8108 – Budgetary and Administrative Attacks on Occupational Safety and Health Regulation

APHA Policy Statement 7845 – The Public Health Impact of Energy Policy

APHA Policy Statement 7629 – Environmental Health Planning

APHA Policy Statement 7434 – The Role of Official Local Health Agencies

APHA Policy Statement 7429 – Encouraging the Safe Use of Bicycles

APHA Policy Statement 7325 – Environmental Quality – Environmental Health: Preventive, Planning, and Regulatory Trends and Methodology

APHA Policy Statement 7228 – Land Use Policy Statement

APHA Policy Statement 7105 – The Motor Vehicle vs. Mass Transportation: Redressing Imbalances

APHA Policy Statement 6815 – Health Research on Housing and the Residential Environment

### Abstract

Unwanted and disturbing sound increases the risk for a variety of negative health outcomes such as heart disease, diabetes, hypertension, hearing loss, and sleep disturbance. While current federal and local policy is fragmented, the infrastructure for greater collaboration is available and ready to be utilized to improve public health outcomes. The American Public Health Association should archive the policy statement on noise from 1975 and advocate for the implementation of a federal noise control plan through the United States National Prevention Strategy. Federal leadership in noise monitoring, research, and education will help local governments abate the negative health outcomes associated with environmental noise pollution.

### Problem Statement

The American Public Health Association has long been a proponent of research, education, and legislation to advance the fight against environmental noise pollution.<sup>1-3</sup> The public health community's understanding of the adverse health impacts of environmental noise pollution has grown rapidly in recent decades. As our understanding has grown, there has

been a disconnection between research and noise policy because many communities and elected officials across the United States are only anecdotally aware of the link between the noise pollution in their communities and their health.<sup>4,5</sup>

Although people often chafe when subjected to traffic noise,<sup>6</sup> many do not have a clear and current understanding of the manifold ways in which noise pollution impacts their health or what they can do to protect themselves from harm.<sup>6,7</sup> Because understanding of the issues surrounding noise pollution has developed exponentially since the federal levels for community noise were promulgated more than 25 years ago, it is our position that the Environmental Protection Agency (EPA) must propose new standards that take into account the accrued evidence of the past quarter century and act to promulgate those standards as required by federal law.<sup>8</sup>

According to the EPA, noise pollution is unwanted or disturbing sound. Sources of noise pollution are numerous and vary according to location (e.g., urban versus rural settings). Sources of outdoor environmental noise include highways, construction activities, urban congestion, power generation, industrial and corresponding occupational exposures, public transportation, recreational vehicles, home power tools, and yard maintenance and air cooling equipment.<sup>9</sup> When calculating health impacts, environmental noise needs to be considered not only with respect to volume (decibels) and length of time emitted, but also in terms of what time it occurs (day or night) and how far a given population is located from the source of the noise. As a result of this multitude of sources and variables, measuring the effects of noise pollution is complex; it is often easier to start with end results and work backward.

Scientific evidence: Chronic environmental noise produces a wide variety of adverse health effects, including fragmented and disrupted sleep,<sup>10,11</sup> annoyance,<sup>12,13</sup> and hearing loss.<sup>14,15</sup> These effects in turn lead to cardiovascular morbidity and mortality,<sup>16,17</sup> neurological/psychiatric sequelae,<sup>18,19</sup> and morbidity associated with hearing loss.<sup>20</sup> Studies that address the home/work environment have demonstrated a dose-response relationship between chronic ambient noise levels and increased blood pressure<sup>21,22</sup>; an increased incidence of heart disease<sup>17</sup>; problems with complex tasks in children, along with attention/learning disabilities and hyperactivity<sup>23</sup>; increased distractibility and annoyance in adults<sup>24</sup>; and an increased incidence of diabetes.<sup>25</sup> Current understanding of the causal pathway from exposure to chronic noise to morbidity/mortality includes repetitive sleep fragmentation and micro-arousal (and its cardiovascular and cognitive effects) as well as noise annoyance (leading to stress and its cognitive effects)<sup>11</sup> and the direct effects of hearing loss from noise. Disordered sleep similarly leads to increases in accidents and learning difficulties among both adults and children.<sup>26</sup> Increased noise annoyance also leads to cognitive difficulties (decreased ability to concentrate, learning problems)<sup>12,27</sup> and stress (which likely contributes to the aforementioned cardiovascular and endocrine effects).<sup>28</sup>

In summary, studies show that stress and feelings of powerlessness due to noise tax the cardiovascular and endocrine systems and increase the long-term risk of hypertension, diabetes, and heart disease.<sup>18,22,24,25,29,30</sup> Annoyance at chronic environmental noise levels has been shown to be an aggravating factor in noise perception and subsequent stress levels.<sup>31</sup> Stress from this annoyance further feeds into exacerbation of cardiac disease through well-studied pathways (e.g., increased sympathetic tone, increased catecholamines and inflammatory cytokines). A recent study indicates that reducing environmental noise pollution has the potential to save lives by decreasing the prevalence of cardiovascular heart disease.<sup>32</sup> In addition to its cardiovascular effects, noise pollution can cause hearing loss, which interrupts individuals' ability to communicate and gather, process, and interpret information around them.<sup>33</sup> The extent of community noise exposures in urban environments points to a high probability of hearing loss, which is a disabling condition that severely affects quality of life. Sleep disturbance due to environmental noise pollution is also well documented, along with annoyance, aggression, decreased helpfulness, and learning difficulties.<sup>12,24,27,34,35</sup>

Extent of the problem: Estimates of the extent of environmental noise in the United States are far from complete, and research has suffered as a result of a deprioritizing of noise; the most recent EPA data expressly on noise pollution are from 1981.<sup>36</sup> Approximately 104 million Americans are at risk of heart disease, hearing loss, and other health effects caused by environmental noise.<sup>37</sup> Recent evidence from outside the United States suggests that the problem is serious; the World Health Organization (WHO) reports that, in Europe, the burden of disease associated with environmental noise pollution from traffic alone is higher than the burden associated with lead exposure, ozone, or radon.<sup>38</sup>

In addition to unwanted and disturbing sounds, a myriad of sources of sound we voluntarily listen to are dangerous; MP3 players can play volumes that cause permanent hearing loss in a matter of minutes, and many youth voluntarily turn their players as loud as they will go.<sup>39</sup> National Health and Nutrition Examination Survey (NHANES) data from 2003–2004 show that 29 million adults in the United States have suffered a hearing loss of 25 dB or more,<sup>40</sup> and an estimated 19.5% of children and adolescents have experienced noise-induced

hearing loss.<sup>41</sup> Noise-induced hearing loss affects 33% to 37% of the US adult population.<sup>14,42</sup> Other sources can damage hearing in a manner of seconds, and guns can cause irreversible hearing loss after a single use.<sup>43</sup>

Noise causes cardiovascular disease through sleep fragmentation and disruption, leading to increased sympathetic stimulation and ultimately higher blood pressure. European noise studies have shown an increasing incidence of fragmented sleep and resultant increases in the incidence of hypertension starting at a nighttime ambient noise level of 45 dB<sup>4,22</sup> and a daytime level of 55 dB.<sup>16</sup> In research done by Seong and colleagues, traffic modeling using the US Department of Transportation programs for road traffic noise showed that 32% of the population of Fulton County, Georgia, is exposed to nighttime noise levels of 50 dB or more, while 64% of the population experiences daytime levels above 55dB.[44] According to WHO noise guidelines, and based on peer-reviewed research, these noise levels translate into 32% of the county's population being at risk of sleep fragmentation and concomitant cardiovascular effects and 64% of the population being at risk of annoyance and its stress-related effects.

Disproportionate impact: Generally, the public cannot control the main sources of noise, such as transit, industry, and air, which means that the public is powerless to reduce associated health impacts without government intervention. Children are particularly vulnerable to noise because noise in schools (particularly in schools located near airports or major highways) impairs attention and memory, which are both critical to language acquisition and learning.<sup>23,45,46</sup> Low-income minority communities are exposed to more environmental noise pollution than other populations, potentially contributing to socioeconomic gaps in public health and education.<sup>40,47-49</sup>

Resource issues: Congress created the Office of Noise Control and Abatement (ONAC) within the EPA in 1972 to coordinate federal monitoring and regulation of noise at its source and facilitate informed policy-making at the state and local levels. In 1978, Congress passed the Quiet Communities Act to expand the scope of ONAC to include public health education and research funding. ONAC issued standards, created model noise ordinances for local governments, and promulgated guidance documents on existing and recommended exposure levels. Since 1981, ONAC has not been active in updating its regulations or enforcing them as a result of funding limitations, leaving most noise control efforts to state and local governments. No rules or standards have been promulgated by the EPA to limit major sources of noise from industry, electronics, appliances, machinery, or recreational items since 1986.<sup>50</sup>

The Occupational Safety and Health Administration, the Department of Transportation, and the Federal Aviation Administration have partnered with industry to reduce exposure to noise in some instances, but these agencies lack the authority to develop a national strategic plan and offer technical assistance to communities with vulnerable populations. As a result, current federal interagency activities are poorly coordinated because each agency has its own methodology, criteria, and approaches to noise control. Environmental impact statements required under the National Environmental Protection Act identify noise as a potential health impact in some federal projects. However, because environmental impact statements do not always fully disclose the nature of the health impacts beyond annoyance, the community and federal agencies do not have complete information when making decisions about whether to implement mitigation strategies and what strategies to implement. The National Institute for Occupational Safety and Health (NIOSH) in the Centers for Disease Control and Prevention (CDC) is tasked with conducting research and making recommendations on occupational health to prevent injury through design, but its limited occupational scope does not include measures to lower community environmental noise pollution. In addition, although NIOSH currently keeps records on power tool sound levels and pressure and vibration levels, it lacks the power to lower those levels.

At the local level, more than 100 communities across the country dealt with noise pollution in the first half of 2013.<sup>51</sup> Many state and local governments have been forced to abandon outdated EPA guidance documents in favor of WHO standards that are not tailored to American soundscapes, populations, or built environments.<sup>52</sup> While numerous health impact assessments conducted by local government and community groups address noise as a health problem of significance that should be considered and addressed, most of these groups do not have the expertise to measure the morbidity and other health effects associated with changes in noise levels. A disincentive exists for local governments to monitor industrial noise, both because of the costs to employ regulatory staff and because of the plausible threat of industry moving to another community that is not as stringent in enforcing its noise regulations. As a result, communities and decision makers are not always aware of the noise-related health impacts on proposed projects, or they have a disincentive to enforce their own noise codes if they think it will cost jobs or tax income.

Proposed Recommendations Statement

Research demonstrates that lives can be saved from reducing noise and that the costs of enforcing noise regulations will be far less than the health care costs associated with heart disease, hearing loss, and lost productivity.<sup>53</sup> The United States National Prevention Strategy brings together numerous federal agencies to collaborate in supporting healthy and safe community environments. The strategy's action plan entails partnering with state, tribal, local, and territorial governments as well as nonprofit organizations, and this plan has the potential to change the way communities conceptualize and solve problems.<sup>54</sup> The Department of Labor, the Department of Transportation, the Department of Health and Human Services, and the Environmental Protection Agency are all part of the United States National Prevention Strategy.

Educating the public, facilitating research, and creating a national noise control strategy can protect the public from the damaging effects of environmental noise pollution.<sup>32</sup> Research and monitoring activity measuring the soundscape and resultant burden of disease can assist policymakers in making informed decisions by mapping which Americans are exposed to dangerous sources of noise, which of them might develop heart disease, the proportion of people who lose sleep owing to traffic noise, and how to best protect the public from the damaging effects of noise pollution. The EPA can assist in public health interventions that educate the public about exposure risks and recommend safe exposure levels. Federal support of health impact assessments is of particularly critical importance so that local governments can incorporate safe standards into their strategic land use planning. Federal noise standards also level the playing field for communities that want to enforce safe noise levels but have been intimidated into lax standard setting and enforcement by aggressive industry players.

A Danish study on employees who started work before and after noise regulations were strengthened showed differences in noise-induced hearing loss,<sup>55</sup> but in another study the same research group stated that these protective measures are followed only if they are compulsory.<sup>56</sup> A 2012 Cochrane review focusing on the efficacy of programs designed to prevent occupational hearing loss showed evidence that these programs do seem to reduce hearing loss in their participants, with the caveat that the data on some of the programs is of very low quality. The review also cited evidence to support the idea that stricter noise legislation leads to diminished noise levels.<sup>57</sup>

Locating schools far from significant noise generation or incorporating them into protected niches of the built environment should be prioritized. Efforts in comprehensive health impact assessments should help in this regard. Quiet pavements in and around schools, along with traffic speed abatement and sound walls, may also be implemented. Quiet pavements should be recognized by the federal government as a noise reduction strategy.<sup>58</sup>

### Opposing Arguments and Evidence

Some believe that there is no room for federal leadership because states and municipalities are better equipped to act locally, controlling noise by placing limits on the time noise can be emitted and interrupting the pathway of noise through building codes and other methods in the built environment. While it is true that local public health agencies have the authority to monitor, investigate, and respond to environmental noise hazards, it is also true that state and local authorities depend on the federal government for research and benchmarking in many fields, and in this respect noise pollution should not be different from other types of environmental pollution.

Because local control of noise has not led to a decrease in noise pollution, and because experts estimate that community noise levels are increasing with increased urbanization,<sup>59</sup> others maintain that the federal government must take a more active regulatory role in noise regulation to reverse these trends.<sup>4</sup> As a result of lack of resources and lack of technical expertise, local governments' efforts rarely include baseline studies to understand what current noise levels are or which efforts most effectively protect community health and safety.

We advocate a partnership between federal and state noise control efforts, as there are certain areas where federal expertise coalitions eliminate state redundancies, and federal funding of research and national agenda setting can be accomplished with greater efficiency. Experts and the federal government agree that controlling noise at its source is more economical and cost effective than attempting to control the path of noise once it is released from the source.<sup>59</sup>

Another criticism levied by critics of federal intervention into reducing the spectrum of noise pollution involves the likely cost of any improvements the federal government may make. This argument has several flaws: it assumes that we are not currently paying a cost for noise pollution, that any increased cost perceived by the American public is not likely to be well tolerated, and that the federal government is not obligated to enforce preexisting laws designed to prevent injury and protect health.

We believe that noise can be an economic driver and urge industry to adopt “greener” engineering as a market niche. For example, one of the main sources of environmental noise is the nation’s highways, and the federal government has a direct responsibility for the noise emitted and burden of disease caused by those roads, either through traffic fatalities or through noise emission. Thus, traffic noise impedance walls, noise-reducing pavement, and quieter engines all need to be considered in cost projections, with the end result being a combination of noise abatement regulations and engineering and built environment interventions to produce habitable cities with protected populations.

As is the case with many other public health initiatives, the best public health strategy with respect to noise pollution is one of cooperation and collaboration among federal, state, and local authorities to build a public health infrastructure that allows for rigorous science and health protection policies. Of primary importance are updated federal standards for noise levels that incorporate the research that shows noise pollution creates a risk of heart disease and hypertension, among other serious health effects. Federal guidance and technical assistance on recommended exposure levels can also help local governments prevent future harm by improving the information contained in health impact assessments and environmental impact statements. In addition, the federal government has the power to regulate noise sources, which is the least costly and most effective way to reduce environmental noise pollution.<sup>59</sup> Research demonstrates that lives can be saved by reducing noise and that the cost of the enforcement of these regulations will be far less than the health care costs associated with heart disease, hearing loss, and lost productivity.<sup>53</sup>

#### Action Steps

Given the pervasiveness and serious adverse health effects associated with noise pollution, the American Public Health Association should archive Policy 7522(PP) (APHA Policy Statement on Noise) and renew its efforts to reduce the public health consequences of environmental noise pollution.;

Therefore, APHA urges:

1. The National Prevention Strategy task force to include environmental noise pollution in its action plan to create healthy and safe community environments.
2. The EPA to collect baseline data on health effects known to be potentially associated with noise exposure, including non-occupational noise-induced hearing loss, heart disease, and hypertension. We further urge monitoring and research regarding noise pollution in the United States, adoption of sound-level standards for major sources of noise such as construction equipment, adoption of noise labeling on products, establishment of updated and revised standards for recommended exposure levels that take into account attendant health risks, and delivery of technical assistance to state and local governments.
3. The CDC, in collaboration with NIOSH, to collect baseline data on the burden of disease known to be potentially associated with noise exposure, including non-occupational noise-induced hearing loss, across communities; identify communities that have vulnerable populations at high risk for noise pollution; improve surveillance of morbidity known to be associated with outdoor noise and excessive sound to inform research; and identify areas with high noise levels that could benefit from intervention.
4. Congress to fund research on and development of noise prevention and mitigation strategies through agencies such as the Department of Health and Human Services and EPA.
5. Entities such as the National Association of County and City Health Officials (NACCHO) to assist local health authorities in educating the public about risks associated with daily exposure to high noise levels.
6. States and municipalities, with the help of the Association of State and Territorial Health Officials and NACCHO, to update noise regulations by incorporating the health effects of noise pollution into existing environmental noise control standards.
7. States and municipalities to incorporate the health effects of noise pollution into comprehensive health impact assessments for future proposals that affect vulnerable populations.
8. Federal agencies to incorporate the health effects of noise pollution into comprehensive environmental impact assessments (as stipulated under the National Environmental Protection Act and with assistance from the EPA) and comprehensive health impact assessments to calculate changes in morbidity, heart disease rates, and other health impacts beyond annoyance.
9. Private industry and equipment manufacturers, in partnership with the Laborers’ Health and Safety Fund of North America, to voluntarily limit product and industrial noise to safe levels that protect against heart disease and hearing loss. We similarly urge private

industry and equipment manufacturers to develop quiet “affordable” solutions and use noise reduction as an agent of competitive advantage in the marketplace.

---

## References

1. American Public Health Association. Policy No. 7522(PP). Available at: <http://www.apha.org/advocacy/policy/policysearch/default.htm?id=800>. Accessed December 7, 2013.
2. American Public Health Association. Policy No. 6818(PP). Available at: <http://www.apha.org/advocacy/policy/policysearch/default.htm?id=610>. Accessed December 7, 2013.
3. American Public Health Association. Policy No. 6407. Available at: <http://www.apha.org/advocacy/policy/policysearch/default.htm?id=518>. Accessed December 7, 2013.
4. Moudon AV. Real noise from the urban environment: how ambient community noise affects health and what can be done about it. *Am J Prev Med*. 2009;37(2):167–171.
5. Browne MW. Research on noise disappears in the din. Available at: <http://www.nytimes.com/1990/03/06/science/research-on-noise-disappears-in-the-din.html?pagewanted=all&src=pm>. Accessed December 7, 2013.
6. City of New York. Noise codes and complaints. Available at: <http://www.nyc.gov/html/dep/html/noise/index.shtml>. Accessed December 7, 2013.
7. Neitzel RL, Gershon RR, McAlexander TP, Magda LA, Pearson JM. Exposures to transit and other sources of noise among New York City residents. *Environ Sci Technol*. 2012;46(1):500–508.
8. Noise Control Act, 42 USC 4905 (1972).
9. Shapiro SA. The dormant Noise Control Act and options to abate noise pollution. Available at: <http://www.nonoise.org/library/shapiro/shapiro.htm>. Accessed December 7, 2013.
10. Basner M, Müller U, Elmenhorst EM. Single and combined effects of air, road, and rail traffic noise on sleep and recuperation. *Sleep*. 2011;34(1):11–23.
11. Zaharna M, Guilleminault C. Sleep, noise and health: review. *Noise Health*. 2010;12(47):64–69.
12. Haines MM, Stansfeld SA, Job RF, Berglund B, Head J. Chronic aircraft noise exposure, stress responses, mental health and cognitive performance in school children. *Psychol Med*. 2001;31(2):265–277.
13. Haralabidis AS, Dimakopoulou K, Velonaki V, et al. Can exposure to noise affect the 24-hour blood pressure profile? Results from the HYENA study. *J Epidemiol Community Health*. 2011;65(6):535–541.
14. Dobie RA. The burdens of age-related and occupational noise-induced hearing loss in the United States. *Ear Hearing*. 2008;29(4):565–577.
15. Haralabidis AS, Dimakopoulou K, Vigna-Taglianti F, et al. Acute effects of night-time noise exposure on blood pressure in populations living near airports. *Eur Heart J*. 2008;29(5):658–664.
16. Babisch W. Road traffic noise and cardiovascular risk. *Noise Health*. 2008;10(38):27–33.
17. Babisch W. Cardiovascular effects of noise. *Noise Health*. 2011;13(52):201–204.
18. Stansfeld S, Crombie R. Cardiovascular effects of environmental noise: research in the United Kingdom. *Noise Health*. 2011;13(52):229–233.
19. Durmer JS, Dinges DF. Neurocognitive consequences of sleep deprivation. *Semin Neurol*. 2005;25(1):117–129.
20. Lin FR. Hearing loss in older adults: who's listening? *JAMA*. 2012;307(11):1147–1148.
21. Babisch W, Kamp I. Exposure-response relationship of the association between aircraft noise and the risk of hypertension. *Noise Health*. 2009;11(44):161–168.
22. van Kempen E, Babisch W. The quantitative relationship between road traffic noise and hypertension: a meta-analysis. *J Hypertens*. 2012;30(6):1075–1086.

23. Clark C, Martin R, van Kempen E, et al. Exposure-effect relations between aircraft and road traffic noise exposure at school and reading comprehension: the RANCH project. *Am J Epidemiol*. 2006;163(1):27–37.
24. Stansfeld S, Haines M, Brown B. Noise and health in the urban environment. *Rev Environ Health*. 2000;15(1–2):43–82.
25. Sørensen M, Andersen ZJ, Nordsborg RB, et al. Long-term exposure to road traffic noise and incident diabetes: a cohort study. *Environ Health Perspect*. 2013;121(2):217–222.
26. Tiesler CM, Birk M. Exposure to road traffic noise and children's behavioural problems and sleep disturbance: results from the GINIplus and LISAplus studies. *Environ Res*. 2013;123:1–8.
27. Lercher P, Evans GW, Meis M, Kofler WW. Ambient neighbourhood noise and children's mental health. *Occup Environ Med*. 2002;59(6):380–386.
28. Ising H, Babisch W, Kruppa B. Noise-induced endocrine effects and cardiovascular risk. *Noise Health*. 1999;1(4):37–48.
29. Maschke C. Cardiovascular effects of environmental noise: research in Germany. *Noise Health*. 2011;13(52):205–211.
30. Jarup L, Babisch W, Houthuijs D, et al. Hypertension and exposure to noise near airports: the HYENA study. *Environ Health Perspect*. 2008;116(3):329–333.
31. Babisch W, Swart W, Houthuijs D, et al. Exposure modifiers of the relationships of transportation noise with high blood pressure and noise annoyance. *J Acoust Soc Am*. 2012;132(6):3788–3808.
32. Gan WQ, Davies HW, Koehoorn M, Brauer M. Association of long-term exposure to community noise and traffic-related air pollution with coronary heart disease mortality. *Am J Epidemiol*. 2012;175(9):898–906.
33. Daniel E. Noise and hearing loss: a review. *J Sch Health*. 2007;77(5):225–231.
34. Kawada T. The effect of noise on the health of children. *J Nippon Med Sch*. 2004;71(1):5–10.
35. Dinno A, Powell C, King MM. A study of riders' noise exposure on Bay Area Rapid Transit trains. *J Urban Health*. 2011;88(1):1–13.
36. Noise in America: Extent of the Noise Problem. Washington, DC: Environmental Protection Agency; 1981.
37. Hammer M, Neitzel R, Swinburn T. Environmental noise pollution in the United States: launching an effective public health response to prevent heart disease, hearing loss, and other health effects. *Environ Health Perspect*. In press.
38. Hanninen O, Knol A. European Perspectives on Environmental Burden of Disease: Estimates for Nine Stressors in Six European Countries. Helsinki, Finland: World Health Organization; 2011.
39. Fligor BJ, Levey S, Levey T. Noise exposure estimates of urban MP3 player users. *J Speech Lang Hear Res*. 2011;54(1):263–277.
40. Agrawal Y, Platz EA, Niparko JK. Prevalence of hearing loss and differences by demographic characteristics among US adults: data from the National Health and Nutrition Examination Survey, 1999–2004. *Arch Intern Med*. 2008;168(14):1522–1530.
41. Shargorodsky J, Curhan SG, Curhan GC, Eavey R. Change in prevalence of hearing loss in US adolescents. *JAMA*. 2010;304(7):772–778.
42. Fingerhut M, Nelson DI, Driscoll T, et al. The contribution of occupational risks to the global burden of disease: summary and next steps. *Med Lav*. 2006;97(2):313–321.
43. Nondahl DM, Cruickshanks KJ, Wiley TL, Klein R, Klein BE, Tweed TS. Recreational firearm use and hearing loss. *Arch Fam Med*. 2000;9(4):352–357.
44. Seong JC, Park TH, Ko JH, et al. Modeling of road traffic noise and estimated human exposure in Fulton County, Georgia, USA. *Environ Int*. 2011;37(8):1336–1341.
45. van Kempen E, van Kamp I, Lebrecht E, Lammers J, Emmen H, Stansfeld S. Neurobehavioral effects of transportation noise in primary schoolchildren: a cross-sectional study. *Environ Health*. 2010;9:25.

46. Stansfeld SA, Berglund B, Clark C, et al. Aircraft and road traffic noise and children's cognition and health: a cross-national study. *Lancet*. 2005;365(9475):1942–1949.
47. Quenqua D. How well you sleep may hinge on race. Available at: [http://www.nytimes.com/2012/08/21/health/how-well-you-sleep-may-hinge-on-race.html?\\_r=0](http://www.nytimes.com/2012/08/21/health/how-well-you-sleep-may-hinge-on-race.html?_r=0). Accessed December 7, 2013.
48. Belojevic G, Evans GW. Traffic noise and blood pressure in low-socioeconomic status, African-American urban schoolchildren. *J Acoust Soc Am*. 2012;132(3):1403–1406.
49. Wu YC, Batterman SA. Proximity of schools in Detroit, Michigan to automobile and truck traffic. *J Expo Sci Environ Epidemiol*. 2006;16(5):457–470.
50. Standards for Highway Operations: Motor Carriers Engaged in Interstate Commerce. Washington, DC: Environmental Protection Agency; 1998.
51. Network for Public Health Law. National survey of state and local noise activity. Available at: [http://www.networkforphl.org/\\_asset/3rvh8q/5-23-13Survey\\_of\\_noise\\_activity\\_4.pdf](http://www.networkforphl.org/_asset/3rvh8q/5-23-13Survey_of_noise_activity_4.pdf). Accessed December 7, 2013.
52. Berglund B, Lindvall T, Schwela DH. WHO Guidelines for Community Noise. Geneva, Switzerland: World Health Organization; 1999.
53. Gan WQ, Davies H, Koehoorn M, Brauer M. Association of long-term exposure to community noise and traffic-related air pollution with coronary heart disease mortality. *Am J Epidemiol*. 2012;175(9):898–906.
54. National Prevention Council. National Prevention Strategy, America's Plan for Better Health and Wellness. Washington, DC: US Department of Health and Human Services; 2011.
55. Rubak T, Kock SA, Koefoed-Nielsen B, Bonde JP, Kolstad HA. The risk of noise-induced hearing loss in the Danish workforce. *Noise Health*. 2006;8(31):80–87.
56. Kock S, Andersen T, Kolstad HA, Kofoed-Nielsen B, Wiesler F, Bonde JP. Surveillance of noise exposure in the Danish workplace: a baseline survey. *Occup Environ Med*. 2004;61(10):838–843.
57. Verbeek J. Interventions to prevent occupational noise-induced hearing loss. *Cochrane Database Syst Rev*. 2012;10:CD006396.
58. Procedures for Abatement of Highway Traffic Noise and Construction Noise. Washington, DC: US Department of Transportation; 2010.
59. García A. Environmental Urban Noise. Boston, MA: WIT Press; 2001.

[Back to Top](#)