HHS Public Access

Author manuscript

Nurs Outlook. Author manuscript; available in PMC 2022 September 26.

Published in final edited form as:

Nurs Outlook. 2017 ; 65(5): 652–656. doi:10.1016/j.outlook.2017.08.001.

Reduce noise: Improve the nation's health

Sally Lechlitner Lusk, PhD, RN, FAAN, FAAOHN[a,*], **Marjorie McCullagh, PhD, RN, PHNA-BC, COHN-S, FAAOHN, FAAN**[a], **Victoria Vaughan Dickson, PhD, RN, FAHA, FAAN**[b], **Jiayun Xu, PhD, RN**[c]

[a]Health Behavior Expert Panel

[b]Environmental & Public Health Expert Panel

[c]American Academy of Nursing Jonas Policy Scholar

Executive Summary

Although noise as a cause of hearing loss and tinnitus among civilian (Hearing health care for adults: Priorities for improving access and affordability, 2016) and military populations (Noise and military service: Implications for hearing loss and tinnitus, 2006) is well known, studies conducted in the past 15 years document that noise exposures negatively affect health by contributing to many diseases, including cardiovascular diseases, obesity, developmental delays, mental illness, and reduced job and academic performance (Basner et al., 2015; Lusk, Gillespie, Hagerty, & Ziemba, 2004; Münzel, Gori, Babisch, & Basner, 2014; Pyko et al., 2015; Ristovska, Laszlo, & Hansell, 2014; Tzivian et al., 2015; Yoon, Hong, Roh, Kim, & Won, 2015). Reducing noise will decrease the incidence of diseases and also decrease health care costs. The American Academy of Nursing supports efforts to determine sources of harmful noise, establish programs (e.g., educational, surveillance, testing) to reduce noise, and promote policies and legislation to control noise exposures (Lusk, McCullagh, Dickson, & Xu, 2016).

Background

Environmental noise, defined as unwanted or disturbing sounds (Clean air act overview: Title IV noise pollution, n.d.), is more than an annoyance; it is a public health hazard. It modifies the function of multiple body organs and systems (Table 1) and has a significant impact on the health of our nation and its economic well-being (Zaharna & Guilleminault, 2010). Reducing noise and the health problems it causes will result in a reduction in disease and health care costs (Swinburn, Hammer, & Neitzel, 2015).

In the United States, noise exposure is linked to multiple diseases that are among the top causes of death, including heart disease, heart attacks, stroke, and high blood pressure (Babisch, 2014; Vienneau, Schindler, Perez, Probst-Hensch, & Röösli, 2015). Sleep disturbance is another severe nonauditory effect of noise, causing acute and chronic sleep disorders that lead to changes in insulin and appetite-regulating hormones (Hume, 2010; Münzel et al., 2014). Noise is associated with several negative emotions, including anger,

[*]*Corresponding author:* Sally Lechlitner Lusk, Health Behavior Expert Panel, 1111 west Clark Rd., Ypsilanti, MI 48198. lusk@umich.edu (S.L. Lusk).

disappointment, dissatisfaction, withdrawal, helplessness, depression, anxiety, distraction, agitation, exhaustion, and stomach discomfort (World Health Organization: European Commission, 2015). Noise affects the health of infants, with noise exposure during pregnancy linked to low birth weight (Ristovska et al., 2014). Children who are exposed to noise also suffer from decreased reading skills and memory, impacting their school performance (Clark et al., 2006) as well as increased distractibility, annoyance (Stansfeld, Haines, & Brown, 2000), aggression, decreased helpfulness, and learning difficulties (Dinno, Powell, & King, 2011; Haines, Stansfeld, Job, Berglund, & Head, 2001; Kawada, 2004; Klatte, Bergstrom, & Lachmann, 2013; Lercher, Evans, Meis, & Kofler, 2002; Stansfeld & Clark, 2015; Stansfeld, Haines, Brown, 2000). Although many people recognize the effects of noise on hearing, fewer are aware that noise is the leading cause of tinnitus (head noises or ringing in the ears), affecting 50 million U.S. adults (Shargorodsky, Curhan, & Farwell, 2010).

The health effects of noise place a high economic burden on our society, which is comparable to the economic impact of passive smoking (Basner et al., 2014). On a global level, the World Health Organization conservatively estimates that at least one million healthy years of life are lost every year in western Europe alone because of traffic-related noise (World Health Organization: European Commission, 2015). Approximately 61,000 healthy years of life are lost because of ischemic heart disease, 45,000 years because of cognitive impairment of children, and 903,000 years because of sleep disturbance (World Health Organization: European Commission, 2015). A reduction in environmental noise levels (within the range of 45–75 dB) by a modest 5 decibels (dB) is expected to reduce the prevalence of hypertension by 1.4% and coronary heart disease by 1.8%, with an annual U.S. economic benefit of $3.9 billion (Swinburn et al., 2015).

These are just a few examples of the debilitating and potentially life-altering effects of environmental noise on health. Effects of environmental noise on health often go unnoticed, as they slowly build over time, and are often not recognized as associated with noise. The public, although generally aware that noise exposures cause hearing loss and tinnitus, is not well informed regarding the other negative effects of noise on health. Although the Environmental Protection Agency (EPA) is responsible at the federal level to control environmental noise, they are not funded to do this work. Therefore, responsibility for specific noise regulations has been left to the states with inadequate results and inconsistencies across the nation.

A 2016 National Academies of Sciences, Engineering, and Medicine report stated that hearing loss is a broad public health issue and that societies have a responsibility to improve the hearing environment for the public (Hearing health care for adults: Priorities for improving access and affordability, 2016). Thus, it is critical that the public be informed regarding the negative effects of noise on health and well-being and that policies and other strategies be developed and implemented to institute appropriate controls.

Noise Levels

Federal agencies, including the National Institute for Occupational Safety and Health (NIOSH) and the Occupational Safety and Health Administration (OSHA), have defined exposure limits for noise *among workers* by indicating length of exposure and decibel levels. The guide of NOISH for workers indicates that at 85 dB, the worker's exposure time is limited to 8 hr. For higher noise exposures, NIOSH reduces the allowable time by half for every 3-dB increase in noise level. Table 2 depicts noise levels from several sources to add meaning to the NIOSH-recommended exposure limits.

Studies documenting the negative effects of environmental noise have defined noise and measured noise exposures in a variety of ways. Although NIOSH and OSHA provide guidelines for length of exposure at different decibel levels for workers, no entity has determined the safe exposure levels for environmental noise for children and adults in the community. Thus, there is a need for the recommended surveillance of sources, further analysis of health effects, and reporting of these findings regarding environmental noise.

Responses and Policy Options

During the past 40 years, there have been numerous federal, international, and public health initiatives to address the health risks posed by inadequately controlled noise. These include the ones discussed here.

Federal and State Legislation

- The Noise Control Act of 1972 (Noise Control Act, 1972) established a national policy to promote an environment for all Americans free from noise that jeopardizes their health and welfare (Shapiro, 1992). Specifically, the act established a means for effective coordination of Federal research and activities in noise control and authorized establishment of Federal noise emission standards for products distributed in commerce. Importantly, the act provided information to the public about noise emission and noise reduction characteristics of these products.
- The Quiet Communities Act of 1978 (Carver, 1988) amended the Noise Control Act of 1972 and placed primary responsibility for noise control at the state and local government levels. The act also authorized the Office of Noise Abatement and Control (ONAC) to create a grants program and offer technical assistance to support state and local noise abatement efforts (Shapiro, 1992).
- The ONAC was created by the EPA following the enactment of the Noise Control Act of 1972. The purpose of ONAC was to regulate noise emission standards, implement product labeling, facilitate the development of low-emission products, coordinate Federal noise reduction programs, assist state and local noise abatement efforts, and promote noise education and research. Although ONAC was defunded in 1982 primarily because of federal budget cuts and the transfer of regulatory power back to state and local governments (Shapiro, 1992), the Noise Control Act of 1972 and Quiet Communities Act of

1978 are still law and remain in effect. The implications of ONAC defunding include lack of EPA resources to set new standards for either previous noise sources or new noise sources and to enforce existing standards. As a result, regulations promulgated by state and local governments to control noise vary widely; and there is a lack of centralized governmental clearing house for noise control and abatement.

Global Recommendations

- *1999 WHO Guidelines for Community Noise* (Berglund, Lindvall, & Schwela, 1999): Set guidelines for community noise and summarized sources of noise, health effects of noise, noise assessment, and noise management across global populations.
- *2002 European Union Directive on Environmental Noise* (European Union directive on environmental noise, 2002): Addressed the assessment and management of environmental noise in member states through strategic noise mapping, estimating population exposure, noise action planning, and dissemination of results to the general public.
- *2009 WHO Night Noise Guidelines for Europe* (Night noise guidelines for Europe, 2009): Updated evidence and recommendations to address targeted limits for night noise.
- *2010 WHO Assessment of Needs for Capacity Building for Health Risk Assessment of Environmental Noise* (Belojevic, Kim, & Kephalopoulos, 2012): Developed guidelines that included the need for consistent implementation of the Environmental Noise Directive 2002/49/European Commission, human resources development through education and training in health risk assessment, and provision of methodological guidelines for health risk assessment of environmental noise exposure.

Professional Organization Statements

- *American Academy of Pediatrics* (Noise: A hazard for the fetus and newborn, 1997): Provided information and recommendations to reduce the health effects of noise among fetuses and newborns.
- *American College of Occupational and Environmental Medicine* (Kirchner et al., 2012): Clarified best practices to diagnose noise-induced hearing loss.
- *American Academy of Audiology* (Position statement: Preventing noise-induced occupational hearing loss, 2003): Described the audiologists' role and responsibilities in the prevention of occupational hearing loss.

Recent U.S. Legislative Actions

Despite widespread agreement that noise exposure poses significant health concerns for children and adults, noise regulations vary widely by state and even within states at regional and local levels. Recognizing the growing health problems related to environmental noise,

U.S. Representative Grace Meng (New York) introduced H.R. 3384 Quiet Communities Act 2015 in the 114th Congress to re-establish the ONAC under the EPA.

A related bill was introduced by U.S. Senator Chuck Schumer (New York) in the U.S. Senate (S. 3197: Quiet Communities Act of 2016). This legislation proposed that the responsibilities of the re-established ONAC will be to develop effective state and local noise control programs; implement a national noise control research program to assess the impacts of noise on mental and physical health; implement a national noise environmental assessment program to identify trends in noise exposure and response, ambient levels, and compliance data and to determine the effectiveness of noise abatement actions; develop and disseminate information and educational materials to the public on the health effects of noise and the most effective means for noise control; develop national and regional educational and training materials and programs; establish regional technical assistance centers to assist state and local noise control programs; and undertake an assessment of the effectiveness of the Noise Control Act of 1972.

The Academy's Position

The American Academy of Nursing supports efforts to reduce noise at its source by requiring production and use of quieter equipment and appliances; implementing measures to reduce airport, railway, and road noise; and enacting legislative restrictions at state and local levels on reducing environmental noise levels, including those at public events (Lusk et al., 2016). The academy will collaborate with federal agencies, state and federal legislators, and nursing/non-nursing organizations to support the reduction of environmental noise.

Recommendations

1. Develop partnerships with federal agencies and organizations working on noise issues (e.g., Centers for Disease Control and Prevention, American Association of Occupational Health Nurses) and media outlets to facilitate the dissemination of noise education programs and noise health information to inform the public regarding noise exposure and its effects on human health.
2. Encourage nurses, physicians, and other health professionals and health organizations to work with their respective members of congress to enact federal legislation to re-establish the EPA ONAC; enact federal legislation to reduce environmental noise; appropriate dedicated funding to develop cost-effective strategies to mitigate the effects of noise on human health; appropriate funding for an EPA clearing house for noise-related policies as a resource for local governments; and urge the administration to create and maintain an environmental noise enforcement and surveillance system.
3. Advocate to the U.S. Department of Transportation to develop specific directives to establish clear industry and government roles in controlling exposure to noise from airports, roads, railways, heavy machinery, and other major noise sources.
4. Encourage the EPA to (a) develop partnerships with universities and/or private organizations to establish a centralized reporting system to measure noise in/

around airports, industrial sites, highways, and others. National, state, and local level noise data could be generated from this system annually to provide a continuous assessment of noise health in the United States and inform future guidelines/policies for noise health; and (b) collaborate with aircraft and machinery manufacturers as well as highway developers to create a penalty and incentive system to make/design/purchase products that are within established noise guidelines.

5. Collaborate with other relevant organizations (e.g., The American Association of Retried Persons, Alliance of Nurses for Healthy Environments, American Medical Association) in the development of national programs to educate the public and health care providers about common noise sources, the ubiquitous nature of noise, groups at high risk for noise (e.g., children), and its effect on national health problems (e.g., obesity, hypertension, cardiovascular disease, prematurity). Programs could be embedded within established health programs such as health education programs in schools and community centers, or programs could be established solely for the dissemination of noise effects on health.

Acknowledgments

The authors express appreciation for guidance and assistance provided by Shannon Zenk, PhD, RN, AOCN, FAAN, Chair, Health Behavior Expert Panel; Matthew J. Williams, JD, MA, Policy Manager and Academy Staff Liaison to the Health Behavior Expert Panel; Linda D. Scott, PhD, RN, NEA-BC, FAAN, Board Liaison to the Health Behavior Expert Panel; and for the review and support by the members of the Health Behavior Expert Panel.

REFERENCES

American Academy of Audiology. (2003). Position statement: Preventing noise-induced occupational hearing loss. Reston, VA: American Academy of Audiology.

American Academy of Pediatrics Committee on Environmental Health. (1997). Noise: A hazard for the fetus and newborn. Pediatrics, 100(4), 724–727. [PubMed: 9836852]

Babisch W (2014). Updated exposure-response relationship between road traffic noise and coronary heart diseases: A meta-analysis. Noise and Health, 16(68), 1–9. [PubMed: 24583674]

Basner M, Babisch W, Davis A, Brink M, Clark C, Janssen S, & Stansfeld S (2014). Auditory and non-auditory effects of noise on health. Lancet, 383(9925), 1325–1332. [PubMed: 24183105]

Basner M, Brink M, Bristow A, … (2015). ICBEN review of research on the biological effects of noise 2011-2014. Noise and Health, 17(75), 57–82. [PubMed: 25774609]

Belojevic G, Kim R, Kephalopoulos S. (2012). Assessment of needs for capacity-building for health risk assessment of environmental noise: Case studies. Retrieved from http://www.noiseineu.eu/%27%27/2920-a/homeindex/file?objectid=2697&objecttypeid=0

Berglund B, Lindvall T, Schwela DH. (1999). Guidelines for community noise. Retrieved from http://www.bvsde.paho.org/bvsci/i/fulltext/noise/noise.pdf

Carver J. Quiet communities act. 1978:Pub. L. No. 95-609, 92 Stat. 3079 (codified at 42 U.S.C. § 4913 (1988).

Clark C, Martin R, van Kempen E, Alfred T, Head J, Davies HW, …, Stansfeld SA (2006). Exposure-effect relations between aircraft and road traffic noise exposure at school and reading comprehension: The RANCH project. American Journal of Epidemiology, 163(1), 27–37. [PubMed: 16306314]

Dinno A, Powell C, & King MM (2011). A study of riders' noise exposure on bay area rapid transit trains. Journal of Urban Health, 88(1), 1–13.

Environmental Protection Agency. Clean air act overview: Title IV noise pollution. Retrieved from http://www.epa.gov/clean-air-act-overview/title-iv-noise-pollution

European Commission. European Union Directive on environmental noise. 2002; Directive 2002/49/EC.

Haines MM, Stansfeld SA, Job RF, Berglund B, & Head J (2001). Chronic aircraft noise exposure, stress responses, mental health and cognitive performance in school children. Psychological Medicine, 31(2), 265–277. [PubMed: 11232914]

Hume K (2010). Sleep disturbance due to noise: Current issues and future research. Noise and Health, 12(47), 70–76. [PubMed: 20472952]

Institute of Medicine. (2006). Noise and military service: Implications for hearing loss and tinnitus. Washington, DC: The National Academies Press.

Kawada T (2004). The effect of noise on the health of children. Journal of Nippon Medical School, 71(1), 5–10. [PubMed: 15129589]

Kirchner DB, Evenson E, Dobie RA, Rabinowitz P, Crawford J, Kopke R, & Hudson TW (2012). Occupational noise-induced hearing loss: ACOEM task force on occupational hearing loss. Journal of Occupational and Environmental Medicine, 54(1), 106–108. [PubMed: 22183164]

Klatte M, Bergstrom K, & Lachmann T (2013). Does noise affect learning? A short review on noise effects on cognitive performance in children. Frontiers in Psychology, 4, 578. [PubMed: 24009598]

Lercher P, Evans GW, Meis M, & Kofler WW (2002). Ambient neighbourhood noise and children's mental health. Occupational and Environmental Medicine, 59(6), 380–386. [PubMed: 12040113]

Lusk SL, Gillespie B, Hagerty BM, & Ziemba RA (2004). Acute effects of noise on blood pressure and heart rate. Archives of Environmental Health, 59(8), 392–399. [PubMed: 16268115]

Lusk SL, McCullagh MC, Dickson VV, & Xu J (2016). Position statement: Harmful effects of environmental noise exposures. Nursing Outlook, 64(4), 395–396. [PubMed: 28575642]

Münzel T, Gori T, Babisch W, & Basner M (2014). Cardiovascular effects of environmental noise exposure. European Heart Journal, 35(13), 829–836. [PubMed: 24616334]

National Academies of Sciences, Engineering, and Medicine. (2016). Hearing health care for adults: Priorities for improving access and affordability. Washington, DC: The National Academies Press.

National Institute for Health and Occupational Safety. (1998). Criteria for a recommended standard: Occupational noise exposure (NIOSH publication no. 98-126). Cincinnati, OH: NIOSH.

Noise control act of 1972. 1972: Pub. L. No. 92-574, 86 Stat. 1234.

Pyko A, Eriksson C, Oftedal B, Hilding A, Östenson CG, Krog NH, …, Pershagen G (2015). Exposure to traffic noise and markers of obesity. Occupational and Environmental Medicine, 72(8), 594–601. [PubMed: 26009579]

Ristovska G, Laszlo HE, & Hansell AL (2014). Reproductive outcomes associated with noise exposure—A systematic review of the literature. International Journal of Environmental Research and Public Health, 11(8), 7931–7952. [PubMed: 25101773]

Shapiro SA (1992). Lessons from a public policy failure: EPA and noise abatement. Ecology Law Quarterly, 19(1), 1–61.

Shargorodsky J, Curhan GC, & Farwell WR (2010). Prevalence and characteristics of tinnitus among US adults. American Journal of Medicine, 123(8), 711–718. [PubMed: 20670725]

Sight and Hearing Association. Noise thermometer. Retrieved from http://www.betterhearing.org/hearingpedia/hearing-loss-prevention/noise-thermometer

Stansfeld S, & Clark C (2015). Health effects of noise exposure in children. Current Environmental Health Reports, 2(2), 171–178. [PubMed: 26231366]

Stansfeld S, Haines M, & Brown B (2000). Noise and health in the urban environment. Reviews on Environmental Health, 15(1-2), 43–82. [PubMed: 10939085]

Swinburn TK, Hammer MS, & Neitzel RL (2015). Valuing quiet: An economic assessment of US environmental noise as a cardiovascular health hazard. American Journal of Preventive Medicine, 49(3), 345–353. [PubMed: 26024562]

Tzivian L, Winkler A, Dlugaj M, Schikowski T, Vossoughi M, Fuks K, …, Hoffmann B (2015). Effect of long-term outdoor air pollution and noise on cognitive and psychological functions in adults. International Journal of Hygiene and Environmental Health, 218(1), 1–11. [PubMed: 25242804]

Vienneau D, Schindler C, Perez L, Probst-Hensch N, & Röösli M (2015). The relationship between transportation noise exposure and ischemic heart disease: A meta-analysis. Environmental Research, 138, 372–380. [PubMed: 25769126]

World Health Organization (WHO). Night noise guidelines for Europe. 2009.

World Health Organization: European Commission. Burden of disease from environmental noise: Quantification of healthy life years lost in Europe. 2015.

Yoon JH, Hong JS, Roh J, Kim CN, & Won JU (2015). Dose-response relationship between noise exposure and the risk of occupational injury. Noise and Health, 17(74), 43–47. [PubMed: 25599757]

Zaharna M, & Guilleminault C (2010). Sleep, noise and health: Review. Noise and Health, 12(47), 64–69. [PubMed: 20472951]

Table 1 –

Examples of Auditory and Nonauditory Effects of Noise on Human Health

Body System	Health Effect
Sensory	Hearing loss and tinnitus
Sleep/rest	Difficulty falling asleep, awakenings, decreased sleep quality, fatigue, and headache
Cardiovascular	Hypertension, heart disease, stroke, and heart attack
Mental and emotional	Declines in verbal and nonverbal learning, psychomotor function, response speed, attentiveness, memory, recall, and helpfulness. Increases in cognitive difficulties, distractibility, annoyance, aggression, and hyperactivity
Reproductive	Low birth weight and prematurity
Endocrine	Overweight and obesity

Table 2 –

Examples of Noise Levels in Decibels (Criteria for a Recommended Standard: Occupational Noise Exposure [NIOSH Publication No. 98-126], 1998; Noise Thermometer, n.d.)

Decibel	Time to Risk of Hearing Damage	Example Sources
140	Immediate	Gunshot and jet engine on takeoff
125	<3 s	Pain threshold; air raid siren, and fire cracker
120	9 s	Rock concert and sandblasting
115	28 s	Baby's cry and stadium football game
110	1 min 29 s	Snowmobile from driver's seat
105	4 min 43 s	Jackhammer and helicopter
100	15 min	Chainsaw and stereo headphones
95	47 min 37 s	Motorcycle and power saw
90	2 hr 31 min	Lawnmower and truck traffic
30	None	Faint sound and whisper

Note. Occupational Safety and Health Administration Hearing Conservation program is mandated at 85 dB.