We are IntechOpen, the world's leading publisher of Open Access books Built by scientists, for scientists

6,900
Open access books available

185,000
International authors and editors

200M
Downloads

Our authors are among the

154
Countries delivered to

TOP 1%
most cited scientists

12.2%
Contributors from top 500 universities



WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?
Contact book.department@intechopen.com

Numbers displayed above are based on latest data collected.
For more information visit www.intechopen.com



Chapter

Vehicular Noise Pollution: Its Environmental Implications and Strategic Control

Zia Ur Rahman Farooqi, Muhammad Sabir, Nukshab Zeeshan, Ghulam Murtaza, Muhammad Mahroz Hussain and Muhammad Usman Ghani

Abstract

Noise pollution has been recognized as one of the major hazard that impacts the quality of life all around the world. Because of the rapid increase in technology, industrialization, urbanization and other communication and transport systems, noise pollution has reached to a disturbing level over the years which needs to be studied and controlled to avoid different health effects like high blood pressure, sleeplessness, nausea, heart attack, depression, dizziness, headache, and induced hearing loss. To address this situation, different countries have different strategies like vehicular noise limits and their regulation, vehicles physical health checkup, different time of operations for noisy traffic like trucks in the evening or night time, and noise pollution fines for noisy vehicles.

Keywords: traffic noise, environment, community effects, human health

1. Introduction

A sound is termed as noise when it becomes continuous and above the threshold limits of the ears [1]. A vehicular noise is the resultant of the vibrating body of the vehicle plus its engine operating sound [2]. Noise has different types including impulsive noise, continuous noise, intermittent noise and low frequency noise. All above mentioned types of noise are dangerous to human and animals if their limits are exceeded [3]. Noise affects people so badly that at some places policy makers were compelled to said that there should be restrictions on noisy vehicles for reducing noise pollution as in New Delhi, India [4] and Guangzhou district, China [5]. Noise is a common problem in urban areas as compared to the villages because of the mechanization and more vehicles on the road [6, 7]. All types of noise altogether affect the same irrespective of the sources and cause headache to the high blood pressure and other heart diseases [8]. Some noise types like aircraft and train noise also has the negative effects on property prices [9, 10]. The noises from cracks in a refrigerator, fan and air conditioner affects evenly as a loud noise of train or aircraft because of its continuity. These results were obtained by a study that the noises in household appliances operations are one of the main sources of noise [11]. It is one of the big problems in industrial areas. It is produced from mechanical

operations, transportation vehicles and different sirens within the industry [12]. Noise also disturbs mining worker and their operations [13]. Due to this noise, workers face different health issues including hearing loss, dizziness, headaches, high blood pressure and anxiety [14, 15]. It is a fact that noise in the vicinity of airports is a public health issue and its exposure affect sleep quality, restlessness and headache [16]. This noise also increases vascular and cerebral oxidative stress and triggers vascular dysfunction [17, 18]. In addition to the above, cargo ships are also the source of nuisance and sleep disturbance. However, these are usually not sources of noise as they affect only small communities living in harbors [19]. Low frequency noise is also included in the noise types and effects humans by annoyance and sleep disturbances [20]. Migraines, tinnitus, nausea, sleep disorders, insomnia, quality of life and minor stress strokes are the result of low frequency noise [21]. Household and community noise is also a health issue. As we live in houses for the major part of the day and we are exposed continuously to different noise types like lawn mower noise, dogs barking, kitchen grinder operation and sound systems/television which seems dangerous. It is given in the documented form that there is an association with several diseases and the growing number of exposed persons all over the world with this type of noise. The effects are ranged from cardiovascular diseases to metabolic disorders [22, 23]. It also has impacts on animals including frogs to the whales and elephants by affecting their reproduction, communication within and with environmental factors, habitat loss and even death [24], and plays important role in geographical distribution of these animals [25].

From all above discussion, it can be clearly seen that health effects of the noise are common as hypertension, myocardial infarction, stroke, mortality, dizziness, high blood pressure and cognitive diseases, irrespective of the noise sources, suggesting the control of all the noise sources [26]. To control the noise, different methods and equipment are made to control or minimize noise from different places like hospitals, educational institutions and workplaces [27]. Adaptive noise control, [28], active noise control, [29], shelter belts [30], equipment and home insulations [31] and active vibration noise control devices are made for this purpose and to reduce the risks of noise [32].

2. Sources of noise pollution

Noise pollution has many sources of which the traffic noise could be a major source. Other types include community noise, household, industrial, aircraft and ships noise [33–41].

2.1 Traffic vehicles

Traffic noise, as depicted by the name, is the noise originated from the traffic vehicles specially the old vehicles with no maintenance and those vehicles which have not been physically cleared to be driven on the roads. Heavy traffic vehicles also contribute in noise generation due to their heavy engines and load [42, 43]. Traffic noise represents the important environmental risk factors in mechanized areas [44] and it is one of the fastest growing and most ubiquitous types of environmental pollution [1]. It is associated with high blood pressure, but the long-term impact may lead to hospitalization and rare chances of death. In a study among London's 8.6 million residents, traffic noise was associated with cardiovascular defects in all adults (≥25 years) and the elderly (≥75 years). It shows that long-term exposure to road traffic noise increases the risk of death and the risk of cardiovascular disease in the population [45].

2.2 Commercial and Industrial noise

Different commercial activities like transportation of goods from one place to other using ships and heavy trucks create considerable noise in the respective areas. Ocean noise levels are increasing as a result of major growth in global trading activities which shows that if this activity continued to grow, which is by 1.9% each year, the contribution of commercial shipping to ambient ocean noise levels will be expected to intensely increase [46]. In addition to the ships, commercial aircrafts are also contributors in commercial and industrial noise. The main source of noise in aircrafts is the engine which generates more noise if the load on it is more [47, 48]. It is a well-known fact that all the machines produce noise and it is called as industrial noise. Different industries have different machinery like textile industry, wood industry and steel mills [49].

To assess the industrial noise effects on workers, all the workers of an industry in Jordan were included in a study. A structured questionnaire was used to collect data. Results revealed that out of total 191 workers, 145 (exposed to higher noise levels) had the issues of hypertension compared to those exposed to noise level lower than the permissible limit indicating that exposure to high level of noise is associated with elevated health risks [50].

2.3 Community noise

Community noise comprised of the noise during a match in the ground, traffic vehicle noise during waste collection, children playing in the streets, dogs barking, and noise during parties [51]. Musical instruments being played can also be a source of noise for someone not interested in music [52, 53]. One study assessed the noise and noise sensitivity of 364 adults living in the South African community and compared them with similar studies conducted in Switzerland. Compared to Swiss research, the proportion of people with high levels of noise sensitivity is higher (women: 35.1% vs. 26.9%, men: 25% vs. 20.5%), people are very angry about road traffic noise (women: 20, 5% compared to 12.4%; male: 17.9% vs. 11.1% were observed in South Africa). Although women in South Africa are more averse to community noise than Switzerland (21.1% vs. 9.4%), this is not the case for men (7.1% vs. 7.8%), suggesting that the noise pollution can seriously affect the inhabitants of the population noise [54].

2.4 Air craft noise

Airplanes such as army, navy and commercial aircraft are noise sources [55]. Airplanes, including army, naval and commercial aircraft, have become one of the most important environmental factors in terms of noise, and industry has identified much of their efforts and concerns. Noise abatement is the focus of modern research and development. Too much noise obviously damages our physical and mental health, so it makes sense to make a technical assessment of the noisy technology. Conflicts of interest in connection with aircraft noise are known. Propeller aircraft are the dominant noise. Many factors that contribute to the sound field in the propeller aircraft lead to extensive research to identify and improve the internal noise reduction techniques as noise sources [56].

2.5 Shipping noise

Anthropogenic noise is now considered a global problem, and recent research has shown that many animals have a multitude of negative effects. Marine

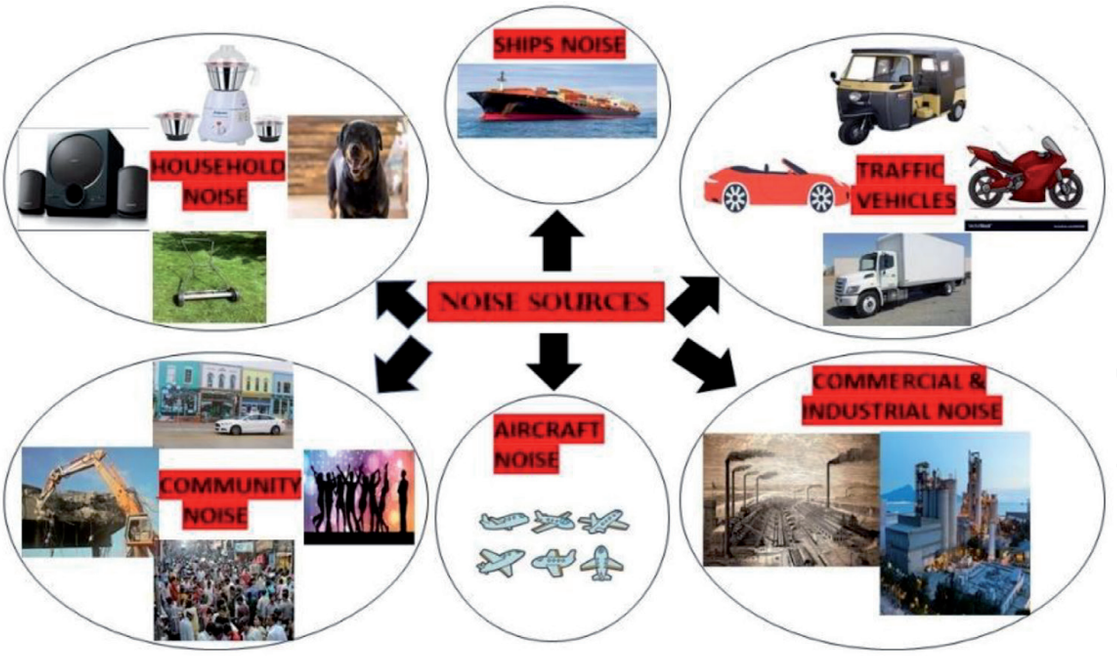


Figure 1.
Different noise sources.

underwater noise is increasingly considered an important and omnipresent pollutant that can affect marine ecosystems globally [57]. Ships and sea vessels are the source of this noise. Noise exposure varies markedly between the sites according to the number of the ships and sea vessels [58]. Due to the shipping noise, marine mammals and other marine life is vulnerable to be at risk as they require relatively quiet place to live but shipping noise could have substantial impacts on them and cause migration [59] (**Figure 1**).

3. Types of noise

Noise has different types according to the intensity, duration and frequency as continuous noise, intermittent noise, impulsive noise and low frequency noise.

3.1 Continuous noise

Continuous noise means the same noise frequency, intensity and quantity which is supplied to people and workers for longer periods of time like machinery operation in textile industry has the same amount, frequency and intensity for 6–8 hours of a working shift [60]. It is the noise which affects the industrial workers health badly by causing headaches to high blood pressure and other heart problems [61].

3.2 Intermittent noise

Noise which can occur at regular or irregular intervals is intermittent. This type of noise includes all the traffic vehicles noise and community noise as these are not the regular and continuously produced and varies with source [62–65].

3.3 Impulsive noise

This type of noise is produced instantly and reduced in the same way. Its types include ticking of clock, striking of hammer on something, water drops falling from

No.	Category/Area	In 1st July 2010		From 1st July 2013	
		Limits in (dB)			
		Day time	Night time	Day time	Night time
1	Residential area	65	50	55	45
2	Commercial area	70	60	65	55
3	Industrial area	80	75	75	65
4	Silence zone	55	45	50	45

Table 1.
Noise level limits in different categorized areas of the city (Pakistan).

height, and all the other noises in impulse forms. This type of noise also disturbs communication between people, induces stress, and anxiety in experimental population [66]. Mitigation of impulsive noise is extensively studied in wireline, wireless radio, and powerline communication systems [3, 67, 68].

3.4 Low frequency noise

Low frequency noise is common with background noise in urban environments and comes from road vehicles, aircraft, industrial machinery, artillery and mining explosions, wind turbines, compressors and ventilation or air conditioning systems. The effects of low-frequency noise are worrying because they are universal (effective propagation) compared to many structures, and many structures (home, wall and hearing protection) are less effective at attenuating low-frequency noise than other sounds. Intense low-frequency sounds seem to produce obvious symptoms, including respiratory disorders and hearing pain. Although it is difficult to determine the effect of low-frequency noise for methodological reasons, there are indications that some of the adverse effects of noise are usually due to low-frequency noise: loudness ratings and disturbing responses are sometimes given for equal sound pressure levels. Low frequency noises are greater than other noises, hum or vibration caused by low frequency noise amplify problems, and speech intelligibility can be reduced by low frequency noise more than other sounds, except for noise in the frequency range of the speech itself due to the upward propagation of the masking [69–72] (**Table 1**).

4. Health effects of noise

In light of the in-depth studies presented in **Table 2**, it can be concluded that traffic accounts for 80% of the environmental impact of noise [73]. It is generally believed that deafness, high blood pressure, ischemic heart disease, discomfort and insomnia, as well as effects on the immune system, are the cause of the noise pollution. In addition to the above diseases, headaches, dizziness, sleeplessness, high blood pressure and hypertension are the common diseases caused by noise.

4.1 On humans

Traffic noise emissions consist of complex components, including horns, engine noise and tire friction. It is estimated that the noise pollution is affected by traffic noise [74], learning disabilities, loss of communication and lack of attention [75, 76]. Epidemiological studies have shown that traffic noise increases the frequency of

arterial diseases, hypertension and strokes as well as vascular dysfunctions [77]. Non-hearing effects such as activity, sleep and communication disorders can trigger a range of emotional reactions, including nuisance and subsequent stress, increased blood pressure and dyslipidemia, increased blood viscosity and blood sugar, and activation of the blood coagulation factor [78, 79]. Due to noise pollution, also higher memory disturbances and oxidative stress were observed [80].

4.1.1 On industrial workers

Occupational noise exposure to workers have adverse effects on workers' health by increasing hypertension, sleep disturbance [81], cardiovascular diseases, blood pressure, hypertension [82, 83], exhaustion and overworking, mistakes performed in various operations due to noise disturbance [84], memory impairment [85], increased pulse rate [86], hearing loss and diabetes [87, 88].

4.1.2 On public

Technology, modernization and residential complexes usually occur near the population, so that the resulting increase in noise is recorded. The environmental impact of noise is closely related to health consequences, including discomfort, sleep disorders and cardiovascular disease [89, 90]. In addition, noise can seriously damage communication, memory function and hearing [91].

4.2 On animals

Noise levels are steadily increasing worldwide and may potentially affect many animal species. Short-term exposure can affect the behavior and physiology of birds, reproductive system as birds avoid reproduction in noisy places [92].

Sr. no.	Human health effects		Effects on animals	
	Effects	**References**	**Effects**	**References**
1	Headache	[97, 98]	Hearing loss	[99]
2	Dizziness	[100]	Increased heart rate	[101]
3	Annoyance	[102]	Increased risk of death	[103]
4	High blood pressure	[104]	Habitat loss	[105]
5	Hypertension	[106]	Trouble in finding prey	[107]
6	Hearing loss	[108]	Trouble in finding mates as in frogs	[109]
7	Depression	[110]	Impaired reproduction in marine mammals	[111]
8	Sleeplessness	[112]	Affects balance system of squid	[113]
9	Physiological Stress	[114]		
10	Irritation	[115]		
11	Difficulty in communication	[116]		
12	Nervousness	[117]		

Table 2.
Noise induced health effects on humans and plants.

Animals also suffer human like disabilities like hearing loss, loss in responsiveness, dizziness and disturbance [93]. Traffic noise reduced foraging efficiency in most bats [94]. Monkeys also live in noise free areas as exhibited by a study in which continuous noise was supplied in the habitat of the monkeys in Brazil, monkeys moved from that area to noise free area indicating that they also do not like noise [95]. Noise effects on wildlife have also been widely studied and results indicated that they also prefer to live away from noise like bears, wolves, ants, lions and larger animals like elephants and whales [96] (**Table 2**).

5. Noise control and minimization

As it is widely discussed that noise has different negative effects on almost all the inhabitants of the planet, it is also one of the priorities that noise should be minimized to avoid the negative health impacts on the humans and animals. Due to its different sources, same technology cannot be used to address all types of noise. So, different technologies are adopted worldwide to overcome the noise impacts. Some of them are discussed below.

5.1 In industrial areas

The incorporation of sustainable industrial planning and development cannot be achieved without proper addressing of the noise pollution. Despite the proven impacts of noise pollution on the worker's health, there remains a lack of systematic methods to reduce the impacts of noise within the industries [118, 119]. One of the major advances have been recently demonstrated for the long-term noise minimizing technology from the Department of Defense, Australia to reduce the workplace exposure from military and industrial noise sources [120]. Application of personal protective equipment like ear plugs and ear mufflers are the general safety measures which are taken by the employer and workers themselves [121]. Sealing of the machinery by using rubber is also used to minimize the vibrations and noise of the machinery in some industries [122]. Glass industry is among the loudest noise producing industries and the workers in these industries are advised to use hearing protection equipment like ear plug or mufflers [123].

A recent technology called operating room technology is set up to address the occupational noise effects in which all the workers of the operating team are issued headsets with microphones. The headsets filter out background noise and the microphones enable interactive communication among and between [124].

5.2 In residential areas

Noise in residential areas is produced by traffic, celebration parties, loud music and playgrounds. Although the noise is a non-market good, the attempts of its evaluation have been increasing, usually by estimating the economic costs arising from exposure to noise, lost prices of property and medical expenses. It is estimated that plots located in the zone with noise exceedance the limits are 57% cheaper than those located in silent zone [125, 126]. The noise in the residential areas can be minimized by shifting to silent zones, using porous materials for house building or porous filters and planting hedges. In addition to this, some suggestion are also given by the authorities like exclusion of the traffic and train horn in or near residential areas, inclusion of noise barriers and removal of the railway tracks [127–129].

5.3 In commercial areas

There is an urgent need to reduce commercial noise being increased day by day due to increased commercial activities [130, 131]. Noise in these areas can be controlled or minimized by limiting transportation activities in markets in daytime, limiting commercial aircraft flights or changing the flight time to night [132].

5.4 In hospitals

Problems related to environmental noise are not confined outside the hospitals, but it became a major issue in the hospitals too. It needs to be solved because silence and peace in hospitals is a major contributor in healing of the patients [133]. Noise pollution in the operating rooms is one of the remaining challenges. Both patients and physicians are exposed to different sound levels during the operative cases, many of which can last for hours. For noise monitoring and control, sound sensors can be installed in patient bed spaces, hallways, and common areas to measure the noise levels and its control accordingly [134, 135]. Reactive noise barriers can also be installed in hospital facilities [136]. As we know that noise is produced from vibration, friction, collision and shocks, so by avoiding these phenomena's, we can avoid noise by using rubber and proper lubrication in machinery [137].

5.5 In educational institutions

The learning environment dramatically affects the learning outcomes of students. Noise is a major factor which can distract students [138], induce attention loss and concentration difficulties, anxiety and headache [139]. To address these problem in educational institutions, traffic noise should be regulated, and traffic can be banned accordingly if found exceeding. School and college bus-stands should be away from the school and colleges. Educational institutions should not be established near the railway tracks, stations and airports [140–142].

6. Conclusion and recommendations

There is a little difference between noise and a sound. A sound can be a noise when it is loud and intensive. Categorization of a sound and noise is also depending upon the choice of the listener and the circumstances. For example, rock music can be pleasurable sound to one person and could be an annoying noise to another person. Likewise, dog's barking is not a noise, but when it becomes continuous and disturbs people, it can be regarded as noise.

Noise has different sources and it can cause hearing loss, dizziness, heat diseases, headaches, high blood pressure, hypertension and nausea based upon the its intensity. To control environmental noise, different techniques and equipment are used according to the situation and requirement. In industries, ear plugs, and mufflers are used, rubber sealing and noise sensors are used in hospitals and shelter belts are used in residential areas for protection against adverse effects of noise. For future, it is necessary to work on reducing the vehicular sources of environmental noise by developing low noise producing automobile vehicles, aircrafts and ships.

Acknowledgements

The authors are highly acknowledged to Mr. Junaid Latif and Mr. Waqas Mohy Ud Din for their precious time given to review this manuscript.

Conflict of interest

The authors declared no conflict of interest for this chapter's publishing.

IntechOpen

IntechOpen

Author details

Zia Ur Rahman Farooqi*, Muhammad Sabir, Nukshab Zeeshan, Ghulam Murtaza, Muhammad Mahroz Hussain and Muhammad Usman Ghani
Institute of Soil and Environmental Sciences, University of Agriculture, Faisalabad, Pakistan

*Address all correspondence to: ziaa2600@gmail.com

IntechOpen

© 2020 The Author(s). Licensee IntechOpen. Distributed under the terms of the Creative Commons Attribution - NonCommercial 4.0 License (https://creativecommons.org/licenses/by-nc/4.0/), which permits use, distribution and reproduction for non-commercial purposes, provided the original is properly cited. BY–NC

References

[1] Zhao J et al. Assessment and improvement of a highway traffic noise prediction model with L eq (20s) as the basic vehicular noise. Applied Acoustics. 2015;**97**:78-83

[2] Nakashima H, Shinkai T, Kakinuma T. Vehicular suction noise transmission system. Google Patents; 2018

[3] Liu S et al. Double kill: Compressive-sensing-based narrow-band interference and impulsive noise mitigation for vehicular communications. IEEE Transactions on Vehicular Technology. 2016;**65**(7):5099-5109

[4] Garg N et al. Effect of odd-even vehicular restrictions on ambient noise levels in Delhi city. In: 2017 International Conference on Advances in Mechanical, Industrial, Automation and Management Systems (AMIAMS); 2017

[5] Cai M et al. Road traffic noise mapping in Guangzhou using GIS and GPS. Applied Acoustics. 2015;**87**:94-102

[6] NIOSH. Preventing Occupational Hearing Loss—A Practical Guide. Cincinnati, Ohio: DHHS (NIOSH) Publication; 1996. pp. 96-110

[7] Klein A et al. Spectral and modulation indices for annoyance-relevant features of urban road single-vehicle pass-by noises. The Journal of the Acoustical Society of America. 2015;**137**(3):1238-1250

[8] Cole JA, Luthey-Schulten Z. Careful accounting of extrinsic noise in protein expression reveals correlations among its sources. Physical Review E. 2017;**95**(6):062418

[9] Beimer W, Maennig W. Noise effects and real estate prices: A simultaneous analysis of different noise sources. Transportation Research Part D: Transport and Environment. 2017;**54**:282-286

[10] Geraghty D, O'Mahony M. Urban noise analysis using multinomial logistic regression. Journal of Transportation Engineering. 2016;**142**(6):04016020

[11] Koruk H, Arisoy A. Identification of crack noises in household refrigerators. Applied Acoustics. 2015;**89**:234-243

[12] Ismail Y, Shadid N, Nizam A. Development of green curtain noise barrier using natural waste fibres. Journal of Advanced Research in Materials Science. 2016;**17**(1):1-9

[13] Sun K, Neitzel RL. What can 35 years and over 700,000 measurements tell us about noise exposure in the mining industry? AU - Roberts, Benjamin. International Journal of Audiology. 2017;**56**(Suppl 1):4-12

[14] Wang Z et al. Noise hazard and hearing loss in workers in automotive component manufacturing industry in Guangzhou, China. Zhonghua Lao Dong Wei Sheng Zhi ye Bing za Zhi [Chinese Journal of Industrial Hygiene and Occupational Diseases]. 2015;**33**(12):906-909

[15] Rizkya I et al. Measurement of noise level in enumeration station in rubber industry. IOP Conference Series: Materials Science and Engineering. 2017;**180**:012121

[16] Nassur A-M et al. The impact of aircraft noise exposure on objective parameters of sleep quality: Results of the DEBATS study in France. Sleep Medicine. 2019;**54**:70-77

[17] Schmidt FP et al. Crucial role for Nox2 and sleep deprivation in aircraft noise-induced vascular and cerebral oxidative stress, inflammation, and gene

regulation. European Heart Journal. 2018;**39**(38):3528-3539

[18] Lawton RN, Fujiwara D. Living with aircraft noise: Airport proximity, aviation noise and subjective wellbeing in England. Transportation Research Part D: Transport and Environment. 2016;**42**:104-118

[19] Badino A et al. Airborne noise emissions from ships: Experimental characterization of the source and propagation over land. Applied Acoustics. 2016;**104**:158-171

[20] Van Kamp I et al. Burden of disease from exposure to low frequency noise: A Dutch inventory. In: ICBEN Proceedings; 2017

[21] Michaud DS et al. Exposure to wind turbine noise: Perceptual responses and reported health effects. The Journal of the Acoustical Society of America. 2016;**139**(3):1443-1454

[22] Recio A et al. Road traffic noise effects on cardiovascular, respiratory, and metabolic health: An integrative model of biological mechanisms. Environmental Research. 2016;**146**:359-370

[23] Baliatsas C et al. Health effects from low-frequency noise and infrasound in the general population: Is it time to listen? A systematic review of observational studies. Science of the Total Environment. 2016;**557-558**:163-169

[24] Tennessen JB, Parks SE, Langkilde TL. Anthropogenic Noise and Physiological Stress in Wildlife. New York, NY: Springer; 2016

[25] Shieh B-S et al. Interspecific comparison of traffic noise effects on dove coo transmission in urban environments. Scientific Reports. 2016;**6**:32519

[26] Stansfeld SA. Noise effects on health in the context of air pollution exposure. International Journal of Environmental Research and Public Health. 2015;**12**(10):12735

[27] Ferrer M et al. Active noise control over adaptive distributed networks. Signal Processing. 2015;**107**:82-95

[28] Wurm M. Adaptive noise control. Google Patents; 2015

[29] Christoph M, Wurm M. Active noise control system. Google Patents; 2016

[30] Dhillon GS et al. Spectroscopic investigation of soil organic matter composition for shelterbelt agroforestry systems. Geoderma. 2017;**298**:1-13

[31] Van Renterghem T. Green roofs for acoustic insulation and noise reduction. In: Nature Based Strategies for Urban and Building Sustainability. United Kingdom: Butterworth-Heinemann-Elsevier; 2018. pp. 167-179

[32] Ohta Y et al. Active vibration noise control device. Google Patents; 2015

[33] Abbaspour M et al. Hierarchal assessment of noise pollution in urban areas—A case study. Transportation Research Part D: Transport and Environment. 2015;**34**:95-103

[34] Aso N et al. Moulins detected as ambient noise sources at the Kaskawulsh Glacier. In: AGU Fall Meeting Abstracts; 2016

[35] Droitcour AD et al. Sources of noise and signal-to-noise ratio. In: Doppler Radar Physiological Sensing. New Jersey: John Willey and Sons; 2016. pp. 137-170

[36] Zannin PHT et al. Evaluation of environmental noise generated by household waste collection trucks. Journal of Environmental Assessment Policy and Management. 2018;**20**(04):1850010

[37] Antoniali M, Versolatto F, Tonello AM. An experimental characterization of the PLC noise at the source. IEEE Transactions on Power Delivery. 2016;**31**(3):1068-1075

[38] Dale LM et al. Socioeconomic status and environmental noise exposure in Montreal, Canada. BMC Public Health. 2015;**15**(1):205

[39] Li S-Q, Xiao W, Sun X-X. Household appliance fault detection based on wavelet denoising and HHT. In: DEStech Transactions on Computer Science and Engineering; 2018

[40] Yang W, Moon HJ. Effects of recorded water sounds on intrusive traffic noise perception under three indoor temperatures. Applied Acoustics. 2019;**145**:234-244

[41] Clark C et al. Association of long-term exposure to transportation noise and traffic-related air pollution with the incidence of diabetes: A prospective cohort study. Environmental Health Perspectives. 2017;**125**(8):087025-087025

[42] Wang X et al. Development of a road shoulder's equivalent sound source traffic noise prediction model. Proceedings of the Institution of Civil Engineers Transport. 2019;**0**(0):1-10

[43] Ware HE et al. A phantom road experiment reveals traffic noise is an invisible source of habitat degradation. Proceedings of the National Academy of Sciences. 2015;**112**(39):12105-12109

[44] Schmidt FP et al. Environmental stressors and cardio-metabolic disease: Part I—Epidemiologic evidence supporting a role for noise and air pollution and effects of mitigation strategies. European Heart Journal. 2017;**38**(8):550-556

[45] Halonen JI et al. Road traffic noise is associated with increased cardiovascular morbidity and mortality and all-cause mortality in London. European Heart Journal. 2015;**36**(39):2653-2661

[46] Kaplan MB, Solomon S. A coming boom in commercial shipping? The potential for rapid growth of noise from commercial ships by 2030. Marine Policy. 2016;**73**:119-121

[47] Hu Y et al. Commercial aircraft cabin noise reduction based on SEA and transfer-matrix method. Noise Control Engineering Journal. 2018;**66**(4):362-374

[48] Meng Q, Sun Y, Kang J. Effect of temporary open-air markets on the sound environment and acoustic perception based on the crowd density characteristics. Science of the Total Environment. 2017;**601-602**:1488-1495

[49] Bozkurt TS, Demirkale SY. The field study and numerical simulation of industrial noise mapping. Journal of Building Engineering. 2017;**9**:60-75

[50] Nserat S et al. Blood pressure of Jordanian workers chronically exposed to noise in industrial plants. International Journal of Occupational and Environmental Medicine. 2017:**8**(4):217-223

[51] Weuve J et al. Long-term exposure to community noise in relation to Alzheimer's disease and related dementias. In: ISEE Conference Abstracts; 2018

[52] Slater J et al. Music training improves speech-in-noise perception: Longitudinal evidence from a community-based music program. Behavioural Brain Research. 2015;**291**:244-252

[53] Keith S, Michaud D. Estimating community tolerance for wind turbine noise annoyance. The Journal of the Acoustical Society of America. 2017;**141**(5):3727-3727

[54] Sieber C et al. Comparison of sensitivity and annoyance to road traffic and community noise between a South African and a Swiss population sample. Environmental Pollution. 2018;**241**:1056-1062

[55] Khozikov V et al. Synergetic noise absorption and anti-icing for aircrafts. Google Patents; 2017

[56] Ommi F, Azimi M. Low-frequency interior noise in prop-driven aircrafts: Sources and control methodologies. Noise & Vibration Worldwide. 2017;**48**(7-8):94-98

[57] Williams R et al. Impacts of anthropogenic noise on marine life: Publication patterns, new discoveries, and future directions in research and management. Ocean and Coastal Management. 2015;**115**:17-24

[58] Merchant ND et al. Soundscape and Noise Exposure Monitoring in a Marine Protected Area Using Shipping Data and Time-Lapse Footage. New York, NY: Springer; 2016

[59] Halliday WD et al. Potential impacts of shipping noise on marine mammals in the western Canadian Arctic. Marine Pollution Bulletin. 2017;**123**(1):73-82

[60] Han J-H, Dimitrijevic A. Continuous noise maskers reduce cochlear implant related artifacts during electrophysiological testing. The Journal of Health Science. 2017;**7**(2):61-62

[61] Usenko VC, Filip R. Trusted noise in continuous-variable quantum key distribution: A threat and a defense. Entropy. 2016;**18**(1):20

[62] Nichols TA, Anderson TW, Širović A. Intermittent noise induces physiological stress in a coastal marine fish. PLoS One. 2015;**10**(9):e0139157

[63] Khoshnevisan D, Kim K. Nonlinear noise excitation of intermittent stochastic PDEs and the topology of LCA groups. The Annals of Probability. 2015;**43**(4):1944-1991

[64] Biao W et al. An adaptive data detection algorithm based on intermittent chaos with strong noise background. Neural Computing and Applications. 2018;**0**:1-8

[65] Zhou H, Li W. Stabilisation of stochastic delayed systems with Lévy noise on networks via periodically intermittent control. International Journal of Control. 2018:1-14

[66] Radford AN et al. Repeated exposure reduces the response to impulsive noise in European seabass. Global Change Biology. 2016;**22**(10):3349-3360

[67] Kuai X et al. Impulsive noise mitigation in underwater acoustic OFDM systems. IEEE Transactions on Vehicular Technology. 2016;**65**(10):8190-8202

[68] Ma W et al. Sparse least mean p-power algorithms for channel estimation in the presence of impulsive noise. Signal, Image and Video Processing. 2016;**10**(3):503-510

[69] Silva MBD et al. A physics-based statistical RTN model for the low frequency noise in MOSFETs. IEEE Transactions on Electron Devices. 2016;**63**(9):3683-3692

[70] Fogarty MA et al. Nonexponential fidelity decay in randomized benchmarking with low-frequency noise. Physical Review A. 2015;**92**(2): 022326

[71] Van Kamp I. Determinants of Annoyance from Humming Sound as Indicator of Low Frequency Noise. Acoustics. 2017;**0**:1-7

[72] Li H et al. A method for low-frequency noise suppression based on mathematical morphology in

microseismic monitoring. Geophysics. 2016;**81**(3):V159-V167

[73] Tobías A et al. Health impact assessment of traffic noise in Madrid (Spain). Environmental Research. 2015;**137**:136-140

[74] Franklin M et al. Assessing the contribution of noise to the association between traffic-related air pollution and children's respiratory health. In: ISEE Conference Abstracts; 2018

[75] Connolly D et al. The effects of classroom noise on the reading comprehension of adolescents. The Journal of the Acoustical Society of America. 2019;**145**(1):372-381

[76] Mayor S. Noise Pollution: WHO Sets Limits on Exposure to Minimise Adverse Health Effects. London, UK: British Medical Journal Publishing Group; 2018

[77] Ullmann E et al. Effects of noise on vascular function, oxidative stress, and inflammation: Mechanistic insight from studies in mice. European Heart Journal. 2017;**38**(37):2838-2849

[78] Münzel T et al. The adverse effects of environmental noise exposure on oxidative stress and cardiovascular risk. Antioxidants & Redox Signaling. 2018;**28**(9):873-908

[79] Injaian AS, Taff CC, Patricelli GL. Experimental anthropogenic noise impacts avian parental behaviour, nestling growth and nestling oxidative stress. Animal Behaviour. 2018;**136**:31-39

[80] Sikandaner HE et al. Neuroprotective effects of sildenafil against oxidative stress and memory dysfunction in mice exposed to noise stress. Behavioural Brain Research. 2017;**319**:37-47

[81] Zare S et al. Evaluation of the effects of occupational noise exposure on serum aldosterone and potassium among industrial workers. Noise & Health. 2016;**18**(80):1-6

[82] Assunta C et al. Noise and cardiovascular effects in workers of the sanitary fixtures industry. International Journal of Hygiene and Environmental Health. 2015;**218**(1):163-168

[83] Lie A et al. Systematic review of the cardiovascular effects of occupational noise. Occupational Medicine. 2016; **66**(1):10-16

[84] Simion S et al. Estimation, Assessment and Effects of Workers Exposure to Physical Noxae. Cham: Springer International Publishing; 2018

[85] Burgess M, Molesworth B. Effects of noise for workers in the transportation industry. The Journal of the Acoustical Society of America. 2017;**141**(5):3804-3804

[86] Yousif KM, Ali FM. Effects of occupational noise exposure on blood pressure and other aspects of health for workers in selected industrial places in Zakho City, Iraq. Science Journal of University of Zakho. 2017;**5**(1):136-141

[87] Lie A et al. Occupational noise exposure and hearing: A systematic review. International Archives of Occupational and Environmental Health. 2016;**89**(3):351-372

[88] Cantley LF et al. Association between ambient noise exposure, hearing acuity, and risk of acute occupational injury. Scandinavian Journal of Work, Environment & Health. 2015;**41**(1):75-83

[89] Hays J, McCawley M, Shonkoff SBC. Public health implications of environmental noise associated with unconventional oil and gas development. Science of the Total Environment. 2017;**580**:448-456

[90] Lusk SL et al. Position statement: Harmful effects of environmental noise exposures. Nursing Outlook. 2016;**64**(4):395-396

[91] Zhidkov SV. Statistical characterization and modeling of noise effects in near-ultrasound aerial acoustic communications. The Journal of the Acoustical Society of America. 2018;**144**(4):2605-2612

[92] Halfwerk W, Slabbekoorn H, Both C. Noise affects nest-box choice of 2 competing songbird species, but not their reproduction. Behavioral Ecology. 2016;**27**(6):1592-1600

[93] Lai J, Bartlett EL. Masking differentially affects envelope-following responses in young and aged animals. Neuroscience. 2018;**386**:150-165

[94] Luo J, Siemers BM, Koselj K. How anthropogenic noise affects foraging. Global Change Biology. 2015;**21**(9):3278-3289

[95] Duarte MHL et al. Mining noise affects loud call structures and emission patterns of wild black-fronted Titi monkeys. Primates. 2018;**59**(1):89-97

[96] Meillere A et al. Traffic noise exposure affects telomere length in nestling house sparrows. Biology Letters. 2015;**11**(9):20150559

[97] Lambert GA, Zagami AS. Does somatostatin have a role to play in migraine headache? Neuropeptides. 2018

[98] Kim J et al. The relationship between occupational noise and vibration exposure and headache/eyestrain, based on the fourth Korean Working Condition Survey (KWCS). PLoS One. 2017;**12**(5):e0177846

[99] Sha S-H, Schacht J. Emerging therapeutic interventions against noise-induced hearing loss. Expert Opinion on Investigational Drugs. 2017;**26**(1):85-96

[100] Elsheshtawy M, Yang F, Prabhu S. Dizziness spells: Should one suspect the pacemaker? The American Journal of Emergency Medicine. 2018

[101] Lyamin OI et al. Cardiorespiratory responses to acoustic noise in belugas. In: The Effects of Noise on Aquatic Life II. Switzerland: Springer Nature; 2016. pp. 665-672

[102] Michaud DS et al. Personal and situational variables associated with wind turbine noise annoyance. The Journal of the Acoustical Society of America. 2016;**139**(3):1455-1466

[103] Da Fonseca J et al. Noise-induced duodenal lesions. European Journal of Anatomy. 2019;**9**(1):29-33

[104] Schmidt F et al. Nighttime aircraft noise impairs endothelial function and increases blood pressure in patients with or at high risk for coronary artery disease. Clinical Research in Cardiology. 2015;**104**(1):23-30

[105] Dähne M et al. Bubble curtains attenuate noise from offshore wind farm construction and reduce temporary habitat loss for harbour porpoises. Marine Ecology Progress Series. 2017;**580**:221-237

[106] Fuks KB et al. Long-term exposure to ambient air pollution and traffic noise and incident hypertension in seven cohorts of the European study of cohorts for air pollution effects (ESCAPE). European Heart Journal. 2017;**38**(13):983-990

[107] McCormick MI et al. Effect of elevated CO_2 and small boat noise on the kinematics of predator–prey interactions. Proceedings of the Royal Society B: Biological Sciences. 2018;**285**(1875):20172650

[108] Kujawa SG, Liberman MC. Synaptopathy in the noise-exposed and aging cochlea: Primary neural degeneration in acquired sensorineural hearing loss. Hearing Research. 2015;**330**:191-199

[109] Ferrari MC et al. School is out on noisy reefs: The effect of boat noise on predator learning and survival of juvenile coral reef fishes. Proceedings of the Royal Society B: Biological Sciences. 2018;**285**(1871):20180033

[110] Seidler A et al. Association between aircraft, road and railway traffic noise and depression in a large case-control study based on secondary data. Environmental Research. 2017;**152**:263-271

[111] Nabi G et al. The possible effects of anthropogenic acoustic pollution on marine mammals' reproduction: An emerging threat to animal extinction. Environmental Science and Pollution Research. 2018;**25**(20):1-8

[112] Kageyama T. Adverse effects of community noise as a public health issue. Sleep and Biological Rhythms. 2016;**14**(3):223-229

[113] Kim M et al. Regulatory evolution and voltage-gated ion channel expression in squid axon: Selection-mutation balance and fitness cliffs. PLoS One. 2015;**10**(4):e0120785

[114] Aminuddin R, Sharkey A. Does interacting with a robot reduce your physiological stress response. New Friends. 2016;**0**(0):1-2

[115] Schneider S et al. Structure-borne noise based diesel engine control. MTZ Worldwide. 2017;**78**(11):76-81

[116] Le Prell CG, Clavier OH. Effects of noise on speech recognition: Challenges for communication by service members. Hearing Research. 2017;**349**:76-89

[117] Geravandi S et al. Noise pollution and health effects. Jundishapur Journal of Health Sciences. 2015;**7**(1):e60312

[118] Hammad A, Akbarnezhad A, Rey D. Accounting for noise pollution in planning of smart cities. In: Smart Cities as a Solution for Reducing Urban Waste and Pollution. IGI Global; 2016. pp. 149-196

[119] Nasir MS et al. Evaluation and analysis of traffic noise in different zones of Faisalabad—An industrial city of Pakistan. Geology, Ecology, and Landscapes. 2017;**1**(4):232-240

[120] Teague P, Conomos J, Jennings M. Noise reduction advances at major defence facilities in Australia. In: INTER-NOISE and NOISE-CON Congress and Conference Proceedings. Institute of Noise Control Engineering; 2016

[121] Nawi NM et al. Occupational Noise Exposure of Construction Workers at Construction Sites in Malaysia. Singapore: Springer; 2018

[122] Hammad AWA, Akbarnezhad A, Rey D. A multi-objective mixed integer nonlinear programming model for construction site layout planning to minimise noise pollution and transport costs. Automation in Construction. 2016;**61**:73-85

[123] Lim MH et al. Strategic noise mapping prediction for a rubber manufacturing factory in Malaysia. In: E3S Web of Conferences. EDP Sciences; 2018

[124] Friedrich MG et al. New technical solution to minimise noise exposure for surgical staff: The 'silent operating theatre optimisation system'. BMJ Innovations. 2017;**3**(4):196-205

[125] Łowicki D, Piotrowska S. Monetary valuation of road noise. Residential property prices as an indicator of the

acoustic climate quality. Ecological Indicators. 2015;**52**:472-479

[126] Hao Y et al. On the relationship between traffic noise resistance and urban morphology in low-density residential areas. Acta Acustica united with Acustica. 2015;**101**(3):510-519

[127] Morandi F et al. Standardised acoustic characterisation of sonic crystals noise barriers: Sound insulation and reflection properties. Applied Acoustics. 2016;**114**:294-306

[128] Bunn F, Zannin PHT. Assessment of railway noise in an urban setting. Applied Acoustics. 2016;**104**:16-23

[129] Van Renterghem T et al. Using natural means to reduce surface transport noise during propagation outdoors. Applied Acoustics. 2015;**92**:86-101

[130] Williams R et al. Approaches to reduce noise from ships operating in important killer whale habitats. Marine Pollution Bulletin. 2019;**139**:459-469

[131] Fang Y, Huang J. Resolving weak light of sub-picowatt per square centimeter by hybrid perovskite photodetectors enabled by noise reduction. Advanced Materials. 2015;**27**(17):2804-2810

[132] Nelson JP. Airport noise, location rent, and the market for residential amenities. Journal of Environmental Economics and Management. 1979;**6**(4):320-331

[133] Gallo LF, Olivera J. Noise pollution control system in the hospital environment. Journal of Physics: Conference Series. 2016;**705**:012942

[134] Kawai Y et al. Quality improvement initiative to reduce pediatric intensive care unit noise pollution with the use of a pediatric delirium bundle. Journal of Intensive Care Medicine. 2019;**34**(5):383-390

[135] Fiedler PEK, Zannin PHT. Evaluation of noise pollution in urban traffic hubs—Noise maps and measurements. Environmental Impact Assessment Review. 2015;**51**:1-9

[136] Monazzam M, Babamahmoodi A, Naderzadeh M. Reactive noise barrier optimization plan for noise pollution reduction in fifteen districts of Tehran. Journal of Air Pollution and Health. 2016;**1**(1):27-34

[137] Korka ZI et al. Gearboxes noise reduction by applying a fluoropolymer coating procedure. Environmental Engineering and Management Journal. 2015;**14**(6):1433-1439

[138] Gilavand A, Jamshidnezhad A. The effect of noise in educational institutions on learning and academic achievement of elementary students in Ahvaz, South-West of Iran. International Journal Of Pediatrics. 2016;**4**(3):1453-1463

[139] Bitar ML, Calaço Sobrinho LF, Simões-Zenari M. Ações para a melhoria do conforto acústico em instituições de educação infantil. Ciência & Saúde Coletiva. 2018;**23**:315-324

[140] Gupta A et al. Noise pollution and impact on children health. The Indian Journal of Pediatrics. 2018;**85**(4):300-306

[141] Yucel M, Kahveci B, Colakkadioglu D. Modelling the adverse health effects of road traffic noise: A case study in Adana, Bulent Angin Boulevard. Journal of International Environmental Application & Science. 2017;**12**(4):325-333

[142] Yadav S, Bilas R. Effect of noise pollution on exposed people of Gorakhpur City. Indian Journal of Scientific Research. 2017;**8**(1):99-107