

## Review Article

# Noise pollution: the silent killer of the century

Ansh Chaudhary<sup>1\*</sup>, Bhupendra Chaudhary<sup>2</sup>

<sup>1</sup>Department of Medicine, Bharati Vidyapeeth Medical College and Research Centre, Pune, Maharashtra, India

<sup>2</sup>Department of Neurology, Jaswant Rai Super Speciality Hospital, Meerut, Uttar Pradesh, India

**Received:** 01 May 2020

**Revised:** 14 May 2020

**Accepted:** 16 May 2020

### \*Correspondence:

Dr. Ansh Chaudhary,

E-mail: [doctorabpl567@gmail.com](mailto:doctorabpl567@gmail.com)

**Copyright:** © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

### ABSTRACT

Labelled as 'silent killer' of 21<sup>st</sup> century, the noise pollution is largely neglected despite its short and long-term ramifications on human health. The noise affects the human beings from intrauterine life to old age in different ways. The ill effects of noise pollution are slow but cumulative in nature with long term health hazards in form of noise induced hearing loss, sleep disturbances, cardiovascular disease and stress etc. The increasing industrialization and modernization have rewarded us with noise as a pollutant so the accusing finger is clearly pointing towards the human activities. The various permissible noise limits in residential, commercial and industrial area should be strictly followed in consonance with the governing law. The violation of these limits should have strict legal consequences.

**Keywords:** Noise, Pollution, Environment, Auditory, Hearing loss

### INTRODUCTION

Noise is defined as an unpleasant, disharmonic, undesired acoustic signal that interferes with one's hearing and concentration, on the other hand sound is referred as pleasant acoustic signal. According to World Health Organization, noise is a modern-day pollutant of 21<sup>st</sup> century affecting both the short and long-term health issues.<sup>1</sup> Short term issues like hearing impairment, sleep deprivation and stress whereas long term consequences could be cardio vascular, endocrinal and behavioral issues. Noise is not only considered as an environmental stressor but is also labelled as a 'silent killer' due to its enormous health hazards.

Noise as a pollutant produces its direct effect on the subject without polluting or modifying the environment like air, water or soil. Despite our ability to measure the noise precisely, its adverse effects on human health have been unfortunately neglected and are still continuing world over.

The increasing industrialization and modernization of last few decades contributed noise as an unseen etiological factor for many of the diseases. All vital organs are adversely affected by noise and the most vulnerable are central nervous system, cardiovascular, endocrinal and immune systems. The noise can be in the form of social noise, recreational noise, environmental noise, transportation noise (train, car, bus, aircraft) or originating from hospitals, markets etc. all are hazardous to the human health. Measuring its dimensions according to the WHO, around 6.3% of the population is affected by hearing impairment and related diseases due to noise pollution.

### SOCIAL AND ENVIRONMENTAL CRITERIA OF NOISE

Zero decibel (dB) is the quietest audible sound a healthy hearing person can hear in absolute noise free environment and each 10 dB increment will double the sound intensity. A whisper is 30 dB, conversational

speech is 60 dB, and someone shouting at you from an arm's length away is 85 dB. Safe limit for short time exposure is 75 dB but with individual variation and susceptibility as some people are prone to develop damage even at lower levels. Exposure to noise greater than 120-125 dB can cause hearing loss or pain in the ears. Permissible noise limits: If the noise levels exceed more than 10 dB than the allowable limit it can have legal consequences as well. The permissible work limit for noise is 8 hours for 90 dB, 4 hours for 95 dB and 2 hours for 100 dB. Silence zone are areas up to 100 metres around hospitals, educational institutions and courts.

**Table 1: Noise-a health hazard for all ages.**

Area	Day (dB)	Night (dB)
Residential	55	45
Commercial	65	55
Industrial	75	70

### IMPACT OF NOISE ON FETAL HEALTH

Harmful effects of noise may start from the more susceptible intrauterine period and continues to a later age. The fetus develops a functional acoustico-vestibular system at around 28 weeks so is the ability to hear. The fetus can respond to auditory stimulus originating from both in-utero and ex-utero in the form of heartbeat of mother, mother's voice, and vibroacoustic stimulations from probe of ultrasound equipment. Noise in the range of 85 to 95 dB during intrauterine period can adversely affect the developing fetus with its long-lasting effects. Apart from its deleterious effect on cochlea with resultant high frequency hearing loss, the intra uterine high exposure of noise may also be responsible for low birth weight, prematurity and also birth defects.<sup>2</sup>

### IMPACT OF NOISE ON NEONATAL AND INFANTILE HEALTH

In neonatal and infantile period, the exposure to high intensity sounds may cause damage to the cilia of cochlea with a high frequency hearing loss. Amongst all, preterm infants are more susceptible to adverse effects of noise. The noisy environment of neonatal intensive care unit (NICU) is produced by monitors, ventilators, alarms, incubators, infusion pumps and conversations between doctors and staff. The recommendable permissible limit should be at or below 45 dB in NICU as suggested by American academy of pediatrics committee (AAP) on environmental health. An increase in heart rate, blood pressure, respiratory rate along with decreased oxygen saturation is noted in new borns who are exposed to sound level of 45 dB or more.

### IMPACT OF NOISE ON CHILDHOOD HEALTH

Children of school going age spend majority of their time in classrooms and playground. Noise in schools may be either external noise from road traffic or surrounding

noisy environment or internal noise as being generated in classrooms by slamming of doors, noisy corridors or poor acoustics of rooms itself.<sup>3</sup> Children surrounded by noisy environments develop stress with resultant decreased learning capability, concentration deficit and behavioral issues.<sup>4</sup> A sudden exposure to high intensity noise can even rupture the eardrum.

The children living in rural homes are less affected with noise exposure as compared to those in urban homes. Development and urbanization in unplanned manner in urban areas the children especially in densely populated cities are more exposed to noisy environment. The condition becomes much more intensified with use of coolers, music systems, washing machine, air conditioners, computer games and televisions.<sup>5,6</sup> Thus it is advisable to discard or exchange the high noisy home appliances or gadgets irrespective of their cost because the damage to health is much costlier.

### IMPACT OF NOISE ON ADULT HEALTH

A developed acoustic-vestibular system of adults is also susceptible for wide range of auditory and non-auditory effects of noise. Varying from individual to individual the degree of habituation of noise is responsible for certain degree of complacency in society.<sup>7</sup> Gradually noise pollution is attaining a major public health problem and according to WHO around 10% of the world population is exposed to auditory and non-auditory effects due to exposure of high sound pressure level. The interplay of genetic and environmental factors along with high sound pressure level that too for a longer duration is responsible for majority of sound related public health issues.<sup>8</sup> The various ill effects of noise on adults can be summarized as below.

### NOISE INDUCED HEARING LOSS

Noise induced hearing loss (NIHL) is a major preventable cause of hearing impairment all over the world. A long-term sustained exposure with sound pressure levels of more than 80-85 dB is the most common cause of NIHL because noise level of more than 75 dB results in cochlear hair cell neuronal destruction due to change in their metabolic activity.<sup>9</sup> The similar changes occur with exposure of very high intense impulse like explosive sounds. The different group of hair cells in cochlea are responsive to different frequencies of sound. Cells line near the base of cochlea are more sensitive to high frequency sound while those at apex to lower frequency. It is these basal cells which are affected predominantly to noise producing high frequency hearing loss. The auditory sensory cells (hair cells) in the organ of corti in the cochlea once degenerates do not have the ability to regenerate hence NIHL is an irreversible damage.<sup>10</sup> Apart from this a sudden and extreme exposure can directly damage the cochlear hair cells. This is called as 'acoustic trauma'. The associated inflammatory and immune mediated defense reaction, if fails, contributes to cochlear

damage via transforming growth factor-B (TGF-B). The therapeutic implication of TGF-B factor enhances the possibility that TGF-B1 peptide inhibitors like P17 and P144 will show promising result by improving the hearing threshold and the degenerative changes.<sup>11</sup> Mice animal models also show that long term omega-3 fatty acids supplementation also ameliorates the progressive hearing loss.<sup>12</sup> Another mechanism of NIHL at molecular level is oxidative stress which may open new frontiers in therapeutic management. Recently genes like NOX-3 and CDH-23 (which are almost exclusively expressed in inner ear) are responsible for high susceptibility in individual having NIHL.<sup>13</sup>

NIHL is also associated with decreased ability to understand, hyperacusis and tinnitus which further incapacitates the individual. Tinnitus can affect quality of life by sleep disturbance, poor attention and associated depression. Traditionally NIHL is associated with industrial noise but recent data points towards 'musical noise' as another important contributor. Children suffering from NIHL develop impaired social and emotional development, decreased educational achievement, poor basic skill development, behavioral problems and withdrawal from society.<sup>14</sup>

### **SLEEP DISTURBANCE AND CARDIOVASCULAR DISEASES**

People living in noisy environments generally develop a subjective habituation but their cardiovascular system does not habituate simultaneously. With activation of autonomic nervous system, the sleep pattern changes from deep stage of sleep to a lighter stage in response to noisy environment. It has been found that REM phase of sleep is suppressed due to noise and micro arousals.<sup>15</sup> Even at 40 dB the noise produces sleep disturbances. Those people who develop sleep fragmentation find themselves difficult to achieve a plateau for sufficient time duration. As a normal physiological response, the blood pressure generally falls during sleep. The rise in blood pressure increases the heart rate due to activation of sympathetic adrenergic system and a resultant increase in level of circulatory stress hormones. The intermittent microarousals in between sleep further adds to increase in cortisol and lipid levels hence an elevated cardiovascular strain. The cascade of increased lipid, heart rate, blood pressure and the stress form a suitable substrate for atherosclerosis and its complication like hypertension, heart disease (MI) and stroke.<sup>16</sup> People who are exposed to more than 60 dB noise level for a longer duration are likely to develop cardiovascular and other noise related ill effects. Chronic noise exposure also increases incidence of diabetes.

### **STRESS**

The increased annoyance and psychological stress due to continuous noise affects the sympathetic adrenergic system particularly in those who have poor adaptability

and more sensitivity. These individuals are also exposed to additional risks of its ill effects. A stressful noise affects the amygdala region of brainstem which triggers the hypothalamus to release adrenaline, noradrenaline and cortisol via adrenal gland. The major health related issues of chronic stress are due to over secretion of these stress related hormones. Annoyance is more prevalent in a community exposed to constant environmental noise. Noise annoyance is generally a trigger for anger, exhaustion, displeasure due to feelings, thoughts and disturbed sleep.<sup>17</sup> It is one of the top environmental hazards in respect to both mental and physical health. It may even lead to personality change of violent reactions.

### **ENVIRONMENT NOISE: THE LEGAL ISSUES**

The supreme court of India in the year 2005 gave an important verdict on noise pollution and ordered to stop unnecessary honking of vehicles and prohibited the use of loud speakers for political purposes, sermons by temples and mosques to prevent noise pollution in residential areas. The government of India in the year 2010, published norms of permissible noise levels both in rural and urban areas. Based on this a national ambient noise monitoring network was created in the country. The network creates base line data and facilitates its analysis for policy makers and implementing agencies to take appropriate actions for noise control both at regional and national level.

### **INDIVIDUAL SUSCEPTIBILITY TOWARDS NOISE**

The following features are responsible for variability in individual susceptibility to NIHL. Smoking, type II diabetes mellitus, previous sensory neural hearing impairment, exposure to ototoxic agents, and altered coagulability states like high blood viscosity, high platelet aggregation.

### **MEDICAL TREATMENT**

No medication has been proved to prevent or repair NIHL. Some evidence of intake of high dose of magnesium prior or soon after exposure to loud noise, if associated with higher dietary antioxidant vitamin intake may have some beneficial effect. Recently combination therapy with corticosteroids and hyperbaric oxygen therapy have been found to be effective for acute acoustic trauma. This therapy is effective if initiated within three days after acoustic trauma.

### **MEASURES TO MINIMISE NOISE POLLUTION**

Encourage safe driving and avoid honking. The use of honking is permissible just to avoid an accident. If intended to use - use soundless fire crackers. Home noise is also dangerous. It is advised that the TV, radio and fans should be kept at a minimum required level of sound preferably less than 60 dB. Pregnant ladies and children

should not be permitted to sit near TV and radio. Break for a few minutes when you use ear phones or head phones to listen to music. Avoid continuous use of mobile phones. It is better to use the phone in speaker mode during longer conversations. MP3 players including iPods can be turned up to a maximum of around 103 dB using standard iPod earphones. Use personal sound protection devices (ear plugs and muffler) when exposed to loud sounds above 80-85 dB.<sup>18,19</sup>

## DISCUSSION

Noise as a result of its highly prevalent auditory and non-auditory health issues is a threat to public health. With increasing urbanization and socialization, the ill effects of noise are showing a steep rise, that too silently. Efforts addressed towards reduced noise exposure will eventually be rewarded by improved sleep, lower level of annoyance, improved learning and concentration in children and lower prevalence of both NIHL and cardiovascular diseases.<sup>20</sup> A better insight in the pathophysiology of NIHL is required to standardize both therapeutic and preventive strategies. With a simple understanding that 'your joy can be someone's noise' the ill effects of noise exposure can be easily changed. This noiseless health hazard of 21<sup>st</sup> century labelled as 'silent killer' should be dealt with utmost priority. It is the need of the hour to have a strict national policy in India to reduce the environmental noise pollution and its related health issues.

## CONCLUSION

Noise as an under estimated pollutant is a silent killer because of its direct and indirect health issues. Noise affects the physical and the psychological health with exposure to elevated sound levels constantly. It is more common and damaging than many people realize. The increasing urbanization and industrialization of present era are responsible for this man-made pollution. It has gained a reputation of a systemic pollutant as it affects auditory, cardio vascular, central nervous, immune and psychosomatic system very gradually and silently. Its harmful effects begin from intrauterine life and continue till old age. The predominant auditory effect is irreversible noise induced hearing loss and its associated psychosomatic effects. A word of discipline at individual and community level under strict national policy is the need of hour to minimize the unwanted effects of the noise pollution.

*Funding: No funding sources*

*Conflict of interest: None declared*

*Ethical approval: Not required*

## REFERENCES

1. Vermeer PW, Passchier WF. Noise exposure and public health. Environ. Health Perspect. 2000;108:123-31.

2. Ando Y, Hatton H. Statistical studies on the effects of intense noise during human fetal life. J Sound Vib. 1973;27:101-10.
3. Hohmann C, Grabenhenrich L, dekluzenaar Y, Tischer C, Heinrich J. Health effects of chronic noise exposure in pregnancy and childhood. Int J Environ Health. 2013;216:217-29.
4. Hetu R, Gagnon T, Bilodeau SA. Problems of noise in school settings: a review of literature and the results of an exploratory study. J Speech Lang Pathol Audiol. 1990;14:31-8.
5. Berglund B, Lindvall T. Community noise. Arch Center Sensory Res. 1995;2:1-195.
6. Babisch W. Noise and health. Environ Health Perspect. 2005;113:14-5.
7. Goines LRN, Louis H. Noise pollution: A modern plague. South Med J. 2007;100:287-94.
8. Basner M, Basisch W, Darvis A, Brink M, Clarck C. Auditory and non-auditory effects of noise on health. Lancet. 2013;383(9925):1325-32.
9. Golz A, Westerman ST. The effect of noise on the vestibular system. Am J otolaryngol. 2001;22:190-6.
10. Taneja MK. Noise induced hearing loss. Indian J Otol. 2014;20:151-4.
11. Cuesta SM, Rosa LR, Contreras J, Celaya AM. Transforming growth factor B1 inhibitor from noise induced hearing loss. Front Aging Neuro Sci. 2015;165:1439-46.
12. Vega PM, Partearroyo T, Vallecillo N, Moreiras GV. Long term omega 3 fatty acid supplementation expression changes in cochlear homocysteine metabolism ameliorates progressive hearing loss in C57BL/6. J Nutr Biochem. 2015;26:1424-33.
13. Kowalski JJ, Pawelczyk M, Rajkowska E. Genetic variants of CDH23 with noise induced hearing loss. Otolneurotol. 2014;35-7.
14. Consensus conference. Noise and hearing loss. JAMA. 1990;263:3185-90.
15. Joey, Yoon CW, Koo DL, Kim D, Hong SB. Adverse effect of 24 hours sleep deprivation on cognition and stress hormones. J Clin Neurol. 2012;8:146-50.
16. Willich SN, Wegscheiderk, Stallmann M, Keil T. Noise burden and the risk of myocardial infarction. Eur Heart J. 2006;27:276-82.
17. Babisch W, Pershagen G, Selander J, Houthuijs D, Breugelmans O, Cadum E, et al. Noise annoyance. A modifier of the association between noise level and cardiovascular health. Sci Total Environ. 2013;452(453):50-7.
18. Harrison RV. The prevention of noise induced hearing loss in children. Int J Pediatr. 2012;2012:473541.
19. Taljaard DS, Leishman NF, Eikelboom RH. Personal listening devices and the prevention of noise induced hearing loss in children: The Cheers for Ears Pilot Program. Noise Health. 2013;15:261-8.

20. Staples SL. Human response to environmental noise. Psychological research and public policy. *Am Psychologist*. 1996;51(2):143-50.

**Cite this article as:** Chaudhary A, Chaudhary B. Noise pollution: the silent killer of the century. *Int J Community Med Public Health* 2020;7:2416-20.