

Assessment of noise induced health hazard: A Review

Manish Dubey¹, Prof. R.K. Bhatia²

¹M.E. Student, ²Associate Professor
Department of Civil Engineering,
Jabalpur Engineering College, Jabalpur

Abstract: Noise pollution arising from indoor or outdoor sources is a potential threat to human health. Individuals residing along the busy traffic lanes, railway tracks and airport and those working in various industries are constantly exposed to sound levels above the physiological exposure limit. Prolonged exposure to high sound levels produce loss of hearing, tinnitus, sleep disturbances, tachycardia, hypertension, coronary artery diseases, annoyance, stress related symptoms and decreased work performance. Adapting suitable modalities to prevent noise pollution may help in combating noise induced health hazards

Keywords: Noise Pollution, Hearing loss, Hypertension, Coronary Artery disease, sleep disturbance, annoyance, stress.

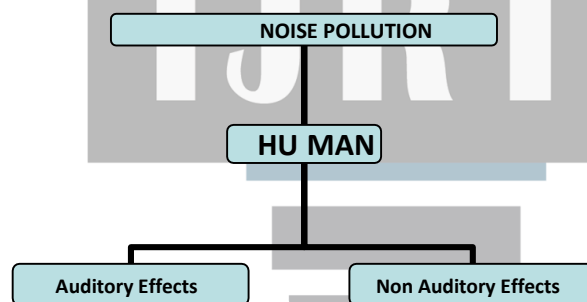
1. INTRODUCTION

Worldwide, noise pollution is emerging as a major environmental hazard to public health. Recently, noise pollution is on the rising trend in India due to the rapidly developing industrialization and urbanization. Increasing number of automobile cars, trucks, autos and two wheelers have become instrumental in producing high vehicular sounds and noise pollution. Poor town planning and lack of space in cities have led to construction of houses near railway tracks, airports, industries and along busy traffic commuting lanes. This has led to the potent risk of exposure of the general population to noise induced health hazards [1, 2, 3].

The improvement in standard of living has further promulgated the exposure to additional indoor source of noise pollution. In this modern era of sophisticated gadgets, use of earphones during prolonged mobile conversations, listening to music on iPod and on MP3 players in car and at home, enjoying the sound effects of home theatre at higher tone and frequent long duration conversations on cell phones and Skype chatting etc., exposes the individuals to sound levels of varying frequencies. Research on noise pollution is gaining due importance due to the growing evidence of the effect of noise on human health. While the association between noise and auditory health is well known, there are also established reports on the non-auditory effects of noise pollution [3, 4].

We surfed through the literature on national and international scientific data bases to analyze the auditory and non-auditory effects of noise pollution, and the suggestive remedial measures to prevent the noise pollution induced health effects in human population.

DISCUSSION



Auditory Effects of Noise pollution:

Noise induced Hearing loss (NIHL), a preventable type of hearing loss is the most common hazard due to prolonged exposure to loud noise. Oxidative stress and damage to the auditory cells in the inner ear have been identified as the cause for hearing loss in individuals exposed to high levels of sound [5, 6, 7]. The extent of auditory damage not only depends on the loudness or intensity of sound but also on the frequency of sound and the duration of exposure to the sound. Exposure to sound levels of more than 85 dB for more than 8 hours have been reported to be potentially dangerous [1] and similarly, low frequency noise are known to produce more health hazards than high frequency noise [8]. Apart from NIHL, chronic exposure to loud noise may also result in tinnitus, auditory fatigue, sleep disturbance, reduced attention span, impaired cognition and decreased work performance. Studies have reported that children are highly susceptible to noise induced hearing loss and its associated health hazards [4, 9, 10].

Non Auditory Effects of Noise pollution Cardiovascular disorder

Exposure to loud noise is known to be associated with high blood pressure and ischemic heart disease [11, 12, 13]. Acute

exposure to loud noise causes activation of the sympathetic nervous system [14] and release of hormones such as the catecholamines and cortisol [15, 16, 17]. These in-turn lead to alterations in the various physiological parameters such as the cardiac output, blood pressure, blood clotting mechanism, blood glucose and blood cholesterol levels [14, 18]. Chronic exposure to loud noise is also associated with reduced glomerular filtration rate which is considered as an important risk factor for cardiovascular disorders [19]. Studies have shown that long term exposure to road traffic, air traffic and rail noise result in increase in blood pressure and increase in the risk of ischemic heart disease and stroke [13, 14, 20, 21, 22, 23, 24].

Sleep disturbance

Sleep, defined as a reversible state of reduced consciousness is characterized by alteration in the electrical activity of the brain, muscle tone and autonomic status. Good quality of sleep is very essential for the normal functioning of the body and mind. Recently, sleep related research activities are gaining more importance due to the increasing incidence of sleep related disorders and its associated co-morbidities in the general population. Chronic sleep loss has varying effects on the cardiovascular, endocrine, immune and nervous system of the individuals resulting in various disorders such as Hypertension [25], Diabetes Mellitus [26], obesity [27, 28], impaired cognition and mood disorders [29].

Exposure to loud environmental noise during night time causes sleep disturbance which is one of the important non-auditory health hazard of noise pollution [2]. Nocturnal noise arousals lead to activation of sympathetic nervous system [30, 31] and endothelial dysfunction resulting in increased cardiovascular morbidity [21]. It is also reported that exposure to loud noise during night time is linked with more cardiovascular health hazards than the exposure to noise at day time [22].

Frequent exposure to noise such as those due to road traffic noise, railway noise and aircraft noise in the night time also reduces the quality of sleep resulting in alterations in the sleep pattern such as increase in duration of superficial sleep stage, decrease in the duration of deep sleep stage and delayed onset of sleep [32]. Disturbance in sleep architecture in turn is known to be associated with increased day time sleepiness, impaired cognition and increased risk of accidents [33, 34, 35]

Annoyance, Psychological disturbance and Cognitive impairment

Annoyance occurs due to acute or chronic exposure to noise resulting in frustration, anger irritability, frequent headaches and nervousness [36, 37, 38, 39, 40]. Low frequency noise especially those associated with vibration and noise of gradually increasing intensity are associated with high levels of annoyance [41] than the high frequency noise. Children, elderly individuals and those with psychiatric disorders are more susceptible to noise induced annoyance [1]. Chronic exposure to loud noise also affects the cognition of the individuals. Studies have shown that children who were constantly exposed to loud noise had poor memory, decreased attention span and difficulties in reading and communication [42, 43, 44]. The combined effect of noise induced annoyance, psychological disturbance and cognitive impairment may affect the overall work performance in workers and learning capacity in school and college goers thus lowering the work output and so also the academic performance in learners.

Immunological effects of Noise Pollution:

Stress induced due to noise pollution results in increased release of catecholamines and glucocorticoids. High levels of glucocorticoids in turn can affect the blood cell population and alter the immune status of the individuals [45].

Social Effect of Noise Pollution

Noise pollution affects human health and thereby produces sickness, absenteeism from work, loss of earning and loss of productivity. Low earning affects standard of living of the individual while low productivity will decrease economic gains of the concerned enterprise, state and the overall economy of the country. Thus noise pollution has a great impact of the quality of life of the individuals. Hence, necessary measures need to be taken to reduce the health hazards of noise pollution.

Prevention of Noise Pollution

Noise pollution can be prevented only when there is an integrated and co-operative approach by the general population, law protection agencies and the government authorities. Though various laws and protective measures have been advocated to prevent noise pollution, these are hardly followed by the public and hence the noise induced health hazards are increasing day by day. Based on various studies, the following are a few preventive measures which would help to curtail noise pollution and its associated health hazards:

1. Implementation of noise standards in different localities.
2. Town planning authorities must ensure that the industrial establishments, railway station, airport, market places and nuclear and thermal power stations are located away from residential areas.
3. Construction of houses, schools and hospitals along busy traffic zone areas should be restricted. Specific silence zones near schools and hospitals must be created and over-usage of horns must be restricted in these areas.
4. Appropriate planning and scheduling must be done to reduce sound arising at or near the construction sites.
5. All sound producing units such as theatres, marriage halls, open air auditoriums, music centers and industrial units should have well insulated sound proof walls. Use of loud speaker in public places must be restricted.
6. Uses of gadgets like MP3 players and sound recorders must be limited to prevent in-house noise pollution.
7. Workers employed in industries which operate high noise producing machines must be provided with ear plugs and ear muffs. Periodical auditory and general health examination must also be done for these individuals.
8. Proper highway planning, limitation of traffic volume and establishment of appropriate speed limits on the highways can help to reduce the sound due to traffic noise.

Planting trees in and around the residential units and near the bus stations, railway stations, airports, industrial areas and vehicle

driving zones will help in absorbing and dissipating the sound, thus acting as effective noise barriers

CONCLUSION

Overall, general awareness about noise pollution and its health hazards must be created among the general population by conducting regular public health campaigns. Future research studies should be targeted towards designing new protocols and protective equipments for preventing noise induced health hazards.

REFERENCES

- [1] Goines L, Hagler L; Noise pollution: a modern plague. *South Med J.*, 2007; 100(3):287–294.
- [2] Muzet A; Environmental noise, sleep and health. *Sleep Med Rev.*, 2007; 11(2):135–142.
- [3] Stansfeld SA, Matheson MP; Noise pollution: non- auditory effects on health. *Br Med Bull.*, 2003; 68(1):243–257.
- [4] Basner M, Babisch W, Davis A, Brink M, Clark C, Janssen S, et al; Auditory and non-auditory effects of noise on health. *Lancet Lond Engl.*, 2014; 383(9925):1325–1332.
- [5] Azizi MH; Occupational noise-induced hearing loss. *Int J Occup Environ Med.*, 2010; 1(3):116– 123.
- [6] Le Prell CG, Yamashita D, Minami SB, Yamasoba T, Miller JM; Mechanisms of noise-induced hearing loss indicate multiple methods of prevention. *Hear Res.*, 2007; 226(1-2):22–43.
- [7] Bahadori RS, Bohne BA; Adverse effects of noise on hearing. *Am Fam Physician.*, 1993; 47(5):1219–1229.
- [8] Berglund B, Hassmén P, Job RFS; Sources and effects of low-frequency noise. *J Acoust Soc Am.*, 1996; 99(5):2985.
- [9] Tiesler CMT, Birk M, Thiering E, Kohlböck G, Koletzko S, Bauer C-P, et al; Exposure to road traffic noise and children’s behavioural problems and sleep disturbance: results from the GINIplus and LISAplus studies. *Environ Res.*, 2013;123:1–8.
- [10] Haines MM, Brentnall SL, Stansfeld SA, Klineberg E; Qualitative responses of children to environmental noise. *Noise Health.* 2003; 5(19):19.
- [11] Willich SN, Wegscheider K, Stallmann M, Keil T; Noise burden and the risk of myocardial infarction. *Eur Heart J.*, 2006; 27(3):276–282.
- [12] Babisch W, Beule B, Schust M, Kersten N, Ising H. Traffic noise and risk of myocardial infarction. *Epidemiol Camb Mass.*, 2005; 16(1):33–40.
- [13] van Kempen EEMM, Kruize H, Boshuizen HC, Ameling CB, Staatsen BAM, de Hollander AEM; The association between noise exposure and blood pressure and ischemic heart disease: a meta- analysis. *Environ Health Perspect.*, 2002; 110(3):307–317.
- [14] Münzel T, Gori T, Babisch W, Basner M; Cardiovascular effects of environmental noise exposure. *Eur Heart J.*, 2014; 35(13):829–836.
- [15] Babisch W; Stress hormones in the research on cardiovascular effects of noise. *Noise Health.*, 2003; 5(18):1–11.
- [16] Ising H, Braun C; Acute and chronic endocrine effects of noise: Review of the research conducted.
- [17] Spreng M; Possible health effects of noise induced cortisol increase. *Noise Health.*, 2000; 2(7):59–64
- [18] Lundberg U; Coping with stress: neuroendocrine reactions and implications for health. *Noise Health.*, 1999; 1(4):67
- [19] Lue S-H, Wellenius GA, Wilker EH, Mostofsky E, Mittleman MA; Residential Proximity to Major Roadways and Renal Function. *J Epidemiol Community Health.*, 2013; 67(8):629–634.
- [20] Balaji R, Rajasegaran R, John NA, Venkatappa US; Hearing Impairment And High Blood Pressure Among Bus Drivers In Puducherry. *J Clin Diagn Res.*, 2016; 10(2):CC08–10
- [21] Schmidt FP, Basner M, Kröger G, Weck S, Schnorbus B, Muttray A et al; Effect of night time aircraft noise exposure on endothelial function and stress hormone release in healthy adults. *Eur Heart J.*, 2013; 34(45):3508–3514a.
- [22] Hume K, Brink M, Basner M; Effects of environmental noise on sleep. *Noise Health.*, 2012 14(61):297.
- [23] Bluhm G, Eriksson C; Cardiovascular effects of environmental noise: research in Sweden. *Noise Health.*, 2011; 13(52):212–216.
- [24] Jarup L, Babisch W, Houthuijs D, Pershagen G, Katsouyanni K, Cadum E et al; Hypertension and Exposure to Noise Near Airports: the HYENA Study. *Environ Health Perspect.*, 2008; 116(3):329–333.
- [25] Wang Q, Xi B, Liu M, Zhang Y, Fu M; Short sleep duration is associated with hypertension risk among adults: a systematic review and meta- analysis. *Hypertens Res.*, 2012; 35:1012–1018.
- [26] Knutson KL, Van Cauter E; Associations between sleep loss and increased risk of obesity and diabetes. *Ann N Y Acad Sci.*, 2008; 1129:287–304
- [27] Patel SR, Hu FB; Short sleep duration and weight gain: a systematic review. *Obes Silver Spring Md.*, 2008; 16(3):643–653
- [28] Cappuccio FP, Taggart FM, Kandala N-B, Currie A, Peile E, Stranges S, et al; Meta-analysis of short sleep duration and obesity in children and adults *Sleep.*, 2008; 31(5):619–626
- [29] Millman RP. Excessive Sleepiness in Adolescents and Young Adults: Causes, Consequences, and Treatment Strategies. *Pediatrics.*, 2005; 115(6):1774–1786
- [30] Griefahn B, Bröde P, Marks A, Basner M; Autonomic Arousals Related to Traffic Noise during Sleep. *Sleep.*, 2008; 31(4):569–577.
- [31] Lusk SL, Gillespie B, Hagerty BM, Ziemba RA; Acute Effects of Noise on Blood Pressure and Heart Rate. *Arch Environ Health Int J.*, 2004; 59(8):392–399.
- [32] Halperin D; Environmental noise and sleep disturbances: A threat to health? *Sleep Sci.*, 2014; 7(4):209–212.
- [33] Elmenhorst E-M, Quehl J, Müller U, Basner M; Nocturnal air, road, and rail traffic noise and daytime cognitive performance

and annoyance. *J Acoust Soc Am.*, 2014; 135(1):213–222.

- [34] Basner M; Nocturnal aircraft noise increases objectively assessed daytime sleepiness. *Somnologie.*, 2008; 12:110–117.
- [35] Passchier-Vermeer W, Passchier WF; Noise exposure and public health. *Environ Health Perspect.*, 2000; 108(Suppl 1):123–131.
- [36] Bodin T, Björk J, Ardö J, Albin M; Annoyance, Sleep and Concentration Problems due to Combined Traffic Noise and the Benefit of Quiet Side. *Int J Environ Res Public Health.*, 2015; 12(2):1612–1628.
- [37] Bruno PS, Marcos QR, Amanda C, Paulo ZHT. Annoyance evaluation and the effect of noise on the health of bus drivers. *Noise Health.*, 2013; 15(66):301–306.
- [38] Ndrepepa A, Twardella D; Relationship between noise annoyance from road traffic noise and cardiovascular diseases: a meta-analysis. *Noise Health.*, 2011; 13(52):251–259.
- [39] Agarwal S, Swami B; Road traffic noise, annoyance and community health survey - A case study for an Indian city. *Noise Health.*, 2011; 13(53):272.
- [40] Bluhm G, Nordling E, Berglind N; Road traffic noise and annoyance--an increasing environmental health problem. *Noise Health.*, 2004; 6(24):43–49.
- [41] Leventhall HG; Low frequency noise and annoyance. *Noise Health.*, 2004; 6(23):59.
- [42] Stansfeld SA, Berglund B, Clark C, Lopez-Barrió, Fischer P, Ohrström E et al; Aircraft and road traffic noise and children's cognition and health: a cross-national study. *Lancet Lond Engl.*, 2005; 365(9475):1942–1949.
- [43] Hygge S, Evans GW, Bullinger M; A prospective study of some effects of aircraft noise on cognitive performance in schoolchildren. *Psychol Sci.*, 2002; 13(5):469–474.
- [44] Bronzaft AL; The effect of a noise abatement program on reading ability. *J Environ Psychol.* 1981; 1(3):215–222.
- [45] Akan Z, Körpınar MA, Tulgar M; Effects of noise pollution over the blood serum immunoglobulins and auditory system on the VFM airport workers, Van, Turkey. *Environ Monit Assess.*, 2010; 177(1-4):537–543.

