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Community Noise Pollution in Urban India: Need for Public Health Action

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Introduction

The decadal growth of the urban population in India rose to 31.8% during the last decade (2001-2011).[1] Rapid urbanization has led to various public health challenges, including environmental pollution. Most activities that cause pollution are essential to meet the needs of the growing population and development. Therefore preventive measures to minimize pollutants are more practical than their elimination. Noise is regarded as a pollutant under the air (Prevention and Control of Pollution) Act, 1981.[2] It has been defined as unwanted sound.[3] Noise consists of unpleasant obtrusive, annoying, distracting, or persistent sounds that interfere with sleep or the ability to concentrate or enjoy life. The WHO guidelines for community noise recommend less than 30 A-weighted decibels (dB[A]) in bedrooms during the night for a sleep of good quality and less than 35 dB(A) in classrooms to allow good teaching and learning conditions. The WHO guidelines for night noise recommend less than 40 dB(A) of annual average (Lnight) outside of bedrooms to prevent adverse health effects from night noise.[4] Noise is an underestimated threat that can cause a number of short- and long-term health problems. It is increasingly becoming a potential hazard to health, physically and psychologically, and affects the general well-being of an individual.[5] Excessive noise interferes with people's daily activities at school, at work, at home, and during leisure time. It can disturb sleep, cause cardiovascular and psychophysiological effects, reduce performance and provoke annoyance responses and changes in social behavior.[6]

Access this article online	
Quick Response Code:	Website: www.ijcm.org.in
	DOI: 10.4103/0970-0218.126342

It also interferes with communication, and this can even endanger life. However, it is a physical pollutant, not visible and the damage occurs silently, going undetected. This is also because sensitivity of the human ear gets automatically adjusted to ambient noise levels, even to increasing noise levels. Moreover, noise pollution control is overshadowed by other types of pollution such as air, water pollution, largely due to lack of awareness about its health implications.[3] Epidemiologic studies on hearing and noise exposure are also lacking although it is the most common preventable cause of sensori-neural hearing loss.

There are two major settings where noise occurs, viz., community noise and industrial noise. Community noise (also called environmental noise, residential noise, or domestic noise) is defined as noise emitted from all sources, except noise at the industrial workplace.[3] Major sources of community noise are automobiles, construction work, loudspeakers, recreational activities, fireworks, etc.

Measurement of Noise

The response of the human ear to sound depends both on the sound frequency (Hertz) and the sound pressure (decibels). The range of hearing by a healthy young person is 20-20,000 Hz.[3] There is individual variability in the sensitivity to different frequencies. Sensitivity to higher frequencies decrease with age and exposure to noise. Noise exposure at one time can occur from various sources, therefore the average sound pressure level over a specific time period is usually measured.

A widely used scale to measure sound pressure levels is the weighting scale, "A-weighting." It correlates with the subjective response of auditory system, and is expressed as decibels in A-Scale (dBA). Though it is simple and convenient to use, it has limitations of poor predictability.[7] Measurement of noise is done by noise level meters, at

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Received: 07-03-12, **Accepted:** 10-08-12

locations where people work. Noise dosimeter, which is worn by the person, has the advantage over noise level meter, of capturing the average noise exposure even while moving around. Impulse-sound level meters are preferably used for measuring impulsive sounds, as their short integration time is appropriate for the short integration time of the cochlea, where injury from noise exposure occurs.

To control the generation of noise by various sources in the environment, the Central Pollution Control Board, under the Ministry of Environment and Forests, Government of India, has set standards of sound for different categories of areas (residential, commercial, industrial and silence zones), separately for day-time and at night [Table 1]. It has also set permissible noise limits for vehicles at the manufacturing stage and noise standards for firecrackers.[8]

Recently, on 23rd March 2011, the Central Pollution Control Board established phase I of the Real Time National Ambient Noise Monitoring Network. It covers 35 locations in seven metro cities (Delhi, Hyderabad, Kolkata, Mumbai, Lucknow, Bangalore, and Chennai). It is a part of the implementation of the National Environmental Policy-2006 (section 5.2.8 [IV]), under which ambient noise is included as an environmental quality parameter. By phase II and phase III, 160 locations spread over 25 cities in 18 states will be established. Ongoing monitoring and appropriate implementation will be possible by this systematic network with central receiving station in Delhi.

Magnitude of Community Noise Pollution

Several studies have been conducted in various parts of the country to assess the ambient noise level. Majority of the total environmental noise is caused by motor vehicles.[9] Day time noise levels measured along roads between two campuses of a University in Balasore, Orissa, ranged from 70.1 dB(A) to 120.4 dB(A) which are above the permissible limits for road traffic noise (70 dB[A]). Noise generated by different vehicles was also measured. None of the vehicles emitted within the permissible limits for road traffic noise.[5] Vehicular air horns emitting loud noise and their misuse have been reported to be the major contributor to high noise levels.[10,11] In a study which measured noise levels in the four zones as categorized by the Central Pollution Control Board, the highest average day-time noise level was detected in silence zones (73.53 dB[A]), i.e., not less than 100 m around hospitals, educational institutions, court, and religious places; and lowest in Residential areas (63.5 dB[A]). The highest average noise level for night time was in traffic intersection areas (71.18 dB[A]) and lowest in the industrial areas.[9]

Table 1: Ambient air quality standards in respect of noise

Area code	Category of area/zone	Limits in dB(A) leq*	
		Day time	Night time
(A)	Industrial area	75	70
(B)	Commercial area	65	55
(C)	Residential area	55	45
(D)	Silence zones	50	40

*dB(A) Leq denotes the time weighted average of the level of sound in decibels on scale A which is relatable to human hearing. Source: Central Pollution Control Board, India

Increasing population, transportation demands, vehicular increase, and congestion of roads are factors that have intensified traffic noise pollution significantly in recent years. Studies assessing noise levels in different settings, week day and holidays, and different zones observed that average noise levels were above the permissible standards.[12-15] Another convenient mode of transport in urban areas, the metro trains, were found to generate noise levels, above the permissible levels of 65 dBA (day) and 55 dBA (night) (commercial zone).[16] Although the ambient noise level is reduced due to its predominant underground location, workers are at higher risk, particularly those stationed at the high noise level areas (engine noise, electric generator etc.).

Daily exposure to such noise levels over a long period can have harmful effects. With rapid urbanization, often unmatched by proper layout of roads, highways and buildings, industrial, residential, and commercial areas lie in close proximity. This disturbs the peaceful environment of residential areas. The ambient noise levels in silence zones were found to go even up to 90 dB.[17] Both day time and night time noise levels in these silence zones were above the permissible limits.[18] It causes distractions and annoyance in not only in institutional areas, but also much discomfort and mental disturbance to patients in hospitals. Night time noise levels in residential areas also exceed the prescribed limits of 55 db(A) in day-time and 45 db(A) at night time.[19]

In addition to the continuous traffic noise which people are exposed to, community festivities, public address systems, noise from machines at construction sites, etc, affect the quality of life. According to a study conducted in a residential area in Delhi during Diwali festival, the average ambient noise level on Diwali ranged from 76 to 80 dB(A), which was 1.2-1.3 times higher than on normal days in the area (57-69 dB[A] Leq).[20] Intense high impact noise emitted by fireworks pose a great risk, and can result in damage to the auditory apparatus. Neighborhood noise can also create an unfriendly atmosphere, misunderstandings, and hostility.

The World Health Organization has listed critical health effects, with corresponding noise levels and exposure time in specific environmental settings.[3]

Health consequences of community noise pollution

The adverse health effects of noise are auditory disorders such as hearing impairment, tinnitus, ear ache, noise-induced hearing loss, and non-auditory manifestations which include headache, psychological disturbances manifested by irritability, inability to concentrate on one's work thereby reducing work efficiency, disturbance in sleep and rest, and interference with speech communication.[21]

Hearing impairment has been defined as an increase in the threshold of hearing.[3] The affected person is unable to understand speech in day-to-day life. Noise-induced hearing impairment mainly occurs in the frequency range of 3,000-6,000 Hz, and with increased exposure, at lower frequencies. Speech intelligibility can be reduced even at 10 dB, averaged over 2,000-4,000 Hz, over both ears. Above 30 dB hearing impairment (averaged over 2,000-4,000 Hz, over both ears), a social hearing handicap is noticeable. Significant hearing impairment occurs on exposure to prolonged exposure to noise levels of 70-85 dB.

Noise-induced hearing loss has been scientifically established as an adverse health effect of noise.[22] In temporary hearing loss, the hearing threshold is elevated temporarily, known as temporary threshold shift. With chronic exposure, permanent threshold shift occurs. In this case, hearing loss becomes permanent due to irreversible damage to the sensory cells of the cochlea. Noise-induced hearing loss usually first affects the hearing threshold at high frequencies above the range of speech perception at around 4 kHz. Hence, it is often not noticed till it becomes severe.[23] The susceptibility of an individual to develop noise-induced hearing loss varies greatly. Therefore, it is difficult to predict the extent of hearing loss a person will acquire when exposed to a certain noise.[21]

Though there are studies in India which have measured the level of community noise, there is scarce published literature on the health effects of community noise pollution. However, such studies have been conducted in various countries. It is highly likely that similar consequences are occurring in India as well.

A study among workers exposed to road traffic noise in Brazil reported that 28.5% had suspected noise-induced hearing loss on audiometric assessment. Those working in noisier areas were more affected (38.8%) than those in areas with lower noise levels (24.2%).[24] Noise-induced hearing loss was estimated among automobile drivers, traffic police, road side hawkers, shop keepers, and garment workers in Bangladesh. More than two-thirds of the participants were unaware of their hearing impairment and 78% had poor knowledge about the adverse effects of noise on health.[25] Tinnitus and hearing loss were reported by traffic policemen, in a study conducted in Bangladesh. Hearing loss was associated with the duration of exposure. With exposure time of 6-10 years, 20% had mild sensori-neural hearing loss and those exposed for 11-20 years, 28% had mild to moderate sensori-neural hearing loss.[26] Noise-induced hearing loss was also detected on audiometric tests among traffic personnel in Malaysia.[27] Auditory morbidity is a serious issue which should not be neglected. It can lead to miscommunication, accidents, loss of livelihood, etc. It can be prevented or greatly reduced by periodic audiometric check-ups, ear protection, and awareness training.

Studies have also reported hypertension to be associated with noise exposure. A study conducted in Pakistan showed that workers exposed to high noise levels were more likely to be hypertensive (Odds ratio: 4.41, confidence interval: 2.123-9.196), and at risk for pre-hypertension (Odds ratio: 3,809; confidence interval: 1.804-8.042) when compared with those working at normal sound levels.[28] Another study observed that residential proximity to high traffic and traffic noise predisposed to higher blood pressure and hypertension.[29] A study conducted in Denmark observed increase in systolic blood pressure per 10 dB(A) increase in 1 year mean road traffic noise levels.[30] Other cardiovascular manifestations with noise exposure have also been studied.[31] A study conducted in Stockholm observed that myocardial infarction was associated with long-term road traffic noise exposure of 50 dBA or higher (adjusted odds ratio = 1.12, 95% confidence interval = 0.95-1.33).[32] The associations have been found to be weak although long-term exposure to LAeq, 24 h values of 65-75 dB are associated with cardiovascular disease, being stronger for ischemic heart disease than hypertension.[3] However, such findings are important as increasing number of people are exposed to such noise levels.

A primary psychologic response to noise is annoyance. At a noise level of 50 dB, an adult can get moderately annoyed, and around 55 dB, seriously annoyed.[3] In a study across Europe, the relation between noise annoyance and medically diagnosed illness was assessed. People who were annoyed by neighborhood noise over a long time were found to be at higher risk for cardiovascular disease, depression, and migraine. People who were persistently annoyed by traffic noise were found to be at higher risk for respiratory health problems. Lower risk of annoyance-induced illness in older persons was suggested to be due to being concealed by senility. Emotional stress triggered by noise was suggested to play a role in the respiratory problems in children.[33]

A study conducted in Orissa found that, though people experienced noise-induced symptoms such as headache,

bad temper, hearing problem, loss of concentration, and sleep disturbance, they were unaware of the ill-effects of noise on health.[10] Noise pollution creates negative emotions of annoyance in the people.[9] Residents living near roadways reported frequent irritation (52%), hypertension (46%), and loss of sleep (48.6%) due to noise pollution.[15] Sleep is disturbed when indoor noise levels are above 30 dB, and 45 dB for sleeping outdoors. After-effects of sleep disturbance include headache and inability of concentrate in one's work and irritability.

Noise exposure among vulnerable groups, such as children, is an area of major concern. A comprehensive study among Austrian children observed that children in the noisier areas had manifested psycho-physiological changes. Resting systolic blood pressure and urinary cortisol were raised. Elevated heart rate to a stressor (reading test), and higher perceived stress symptoms were also observed.[34] In another study, children exposed to higher noise levels had different physiological parameters, viz., high blood pressure and low heart rate, when compared with those in quieter areas.[35] Children exposed to aircraft and road traffic noise had impaired cognition such as reading comprehension, recall, and reported annoyance.[36] Early hearing impairment in children is a grave consequence of continuous exposure to noise. High impact loud sounds can cause more damage. Toys and fireworks are the major sources of such damaging sounds.

Another serious issue is the exposure of young people to high noise levels which exceed 100 dB LAeq, in places of entertainment. LAeq is the Equivalent Continuous Level. When a noise varies over time, the Leq is the equivalent continuous sound which would contain the same sound energy as the time-varying sound. Frequent exposure to such high noise levels could significantly cause hearing impairment.[7]

As per the Global Burden of Disease Report 2004 of the World Health Organization, the global prevalence of moderate to severe hearing loss (41 decibels or greater) was 278 million, and mild hearing loss (26-40 decibels) was 306 million. In India, the prevalence of hearing loss was estimated to be 63 million (6.3%).[37] It is a common cause of Years lived with disability.

Recommendations

Fortunately, hearing loss due to community noise pollution is largely preventable. Preventive and control measures have been recommended, viz., stringent implementation of legislation, efficient engineering products, proper planning of roadways, considering their proximity to human settlements. In industry setting, personal protective equipment such as ear muffs and ear plugs are required.[38] Good practices to prevent noise-induced ailments in children should be adopted.[39] Noise attenuation by placing vegetations around buildings have also been recommended.[40,41] Recommendations of the Delhi Pollution Control Committee include ban on pressure horns, phasing out of three wheeler autos, extensive plantation of trees on the roadsides, encouraging use of noise-absorbent materials, adequate noise barriers around silence zones, monitoring of loudspeaker, and generator sets to ensure compliance with prescribed rules.

Above all, awareness of the public and stakeholders is the key component in the prevention and control of community noise pollution. Basic and essential information should be extensively disseminated, such as noise levels created by common sources of noise pollution, adverse health effects on both the person creating noise, and the public preventive measures and conditions punishable under law.[42] Graphic displays in public places are a good medium to spread the message. School campaigns, health education programs, and publicizing through print and electronic media can actively address this issue. Involvement of non-governmental organizations in generating public interest and co-operation, and providing audiological facilities will immensely help the cause.

Further exploratory studies are urgently required in India. Socio-demographic factors and determinants of noise-induced health effects, co-morbidities, population-specific thresholds for normal or impaired hearing should be studied.

References

1. Census of India 2011. Provisional Population Totals. Paper 2, Volume 1 of 2011. Rural-Urban Distribution India series 1. Office of the Registrar General & Census Commissioner, India. 2011. Available from: http://www.censusindia.gov.in/2011-prov-results/paper2/data_files/india/paper2_at_a_glance.pdf. [Last accessed on 2011 Dec 3].
2. Ministry of Environment and Forests, Government of India. No.14 of 1981, [29/03/1981]-The Air (Prevention and Control of Pollution) Act, 1981, amended 1987. Available from: http://www.moef.nic.in/legis/air/air1.html. [Last accessed on 2011 Dec 6].
3. Guidelines for Community Noise. In: Berglund B, Lindvall T, Schwela HD, editors. World Health Organization, Geneva, Cluster of Sustainable Development and Healthy Environment (SDE), Department for Protection of the Human Environment (PHE), Occupational and Environment Health) (OEH). 1999.
4. Noise: Facts and Figures. World Health Organization. 2011. Available from: http://www.euro.who.int/en/what-we-do/health-topics/environment-and-health/noise/facts-and-figures. [Last accessed on 2012 Aug 13].
5. Goswami S, Nayak SK, Pradhan AC, Dey SK. A study on traffic noise of two campuses of University, Balasore, India. J Environ Biol 2011;32:105-9.
6. Noise. World Health Organization. 2011. Available from: http://www.euro.who.int/en/what-we-do/health-topics/environment-and-health/noise. [Last accessed on 2012 Aug 13].

7. Berglund B, Lindvall T. Community noise. Archives of the Center for Sensory Research 1995;2:1- 195. Available from: http://www.nonoise.org/library/whonoise/whonoise.htm. [Last accessed on 2011 Dec 7].
8. Central Pollution Control Board, Ministry of Environment and Forests, Govt. of India. Available from: http://cpcb.nic.in/Noise_Standards.php. [Last accessed on 2011 Dec 4].
9. Banerjee D, Chakraborty SK, Bhattacharyya S, Gangopadhyay A. Evaluation and analysis of road traffic noise in Asansol: An industrial town of eastern India. Int J Environ Res Public Health 2008;5:165-71.
10. Patel R, Tiwari TN, Patel T. Noise pollution in residential areas of Jharsuguda Town, Orissa (India) and its impact. J Environ Sci Eng 2006;48:209-12.
11. Agarwal S, Swami BL. Comprehensive approach for the development of traffic noise prediction model for Jaipur city. Environ Monit Assess 2011;172:113-20.
12. Bhosale BJ, Late A, Nalawade PM, Chavan SP, Mule MB. Studies on assessment of traffic noise level in Aurangabad city, India. Noise Health 2010;12:195-8.
13. Vidya Sagar T, Nageswara Rao G. Noise pollution levels in Visakhapatnam City (India). J Environ Sci Eng 2006;48:139-42.
14. Kisku GC, Sharma K, Kidwai MM, Barman SC, Khan AH, Singh R, *et al*. Profile of noise pollution in Lucknow city and its impact on environment. J Environ Biol 2006;27:409-12.
15. Agarwal S, Swami BL. Road traffic noise, annoyance and community health survey - a case study for an Indian city. Noise Health 2011;13:272-6.
16. Bhattacharya SK, Bandyopadhyay P, Kashyap SK. Calcutta metro: Is it safe from noise pollution hazards? Ind Health 1996;34:45-50.
17. Datta JK, Sadhu S, Gupta S, Saha R, Mondal NK, Mukhopadhyay B. Assessment of noise level in Burdwan town, West Bengal. J Environ Biol 2006;27:609-12.
18. White paper on pollution in Delhi. Ministry of Environment and Forests, Government of India. 1997. Available from: http://www.envfor.nic.in/divisions/cpoll/delpolln.html. [Last accessed on 2011 Dec 3].
19. Banerjee D, Chakraborty SK. Monthly variation in night time noise levels at residential areas of Asansol city (India). J Environ Sci Eng 2006;48:39-44.
20. Mandal P, Prakash M, Bassin JK. Impact of Diwali celebrations on urban air and noise quality in Delhi City, India. Environ Monit Assess 2012;184:209-15.
21. Stansfeld SA, Matheson MP. Noise pollution: Non-auditory effects on health. Br Med Bull 2003;68:243-57.
22. Borchgrevink HM. Does health promotion work in relation to noise? Noise Health 2003;5:25-30.
23. Moller, A.R.: Effects of the Physical Environment: Noise AS a Health Hazard, Ed. Wallace RB, Maxcy-Rosenau-Last, Public Health and Preventive Medicine, Fourteenth Edition, USA, McGraw Hill Companies; 2007. p. 755-61.
24. Barbosa AS, Cardoso MR. Hearing loss among workers exposed to road traffic noise in the city of São Paulo in Brazil. Auris Nasus Larynx 2005;32:17-21.
25. Chakraborty MR, Khan HS, Samad MA, Amin MN. Noise level in different places of Dhaka Metropolitan City (DMC) and noise-induced hearing loss (NIHL) in Dhaka City dwellers. Bangladesh Med Res Counc Bull 2005;31:68-74.
26. Sharif A, Taous A, Siddique BH, Dutta PG. Prevalence of noise induced hearing loss among traffic police in Dhaka Metropolitan City. Mymensingh Med J 2009;18:S24-28.
27. Thomas N, Mariah AN, Fuad A, Kuljit S, Philip R. Noise exposure and noise induced hearing loss among Kuala Lumpur traffic point duty personnel. Med J Malaysia 2007;62:152-5.
28. Nawaz SK, Hasnain S. Noise induced hypertension and prehypertension in Pakistan. Bosn J Basic Med Sci 2010;10:239-44.
29. Fuks K, Moebus S, Hertel S, Viehmann A, Nonnemacher M, Dragano N, *et al*. Long-term urban particulate air pollution, traffic noise, and arterial blood pressure. Environ Health Perspect 2011;119:1706-11.
30. Sørensen M, Hvidberg M, Hoffmann B, Andersen ZJ, Nordsborg RB, Lillelund KG, *et al*. Exposure to road traffic and railway noise and associations with blood pressure and self-reported hypertension: A cohort study. Environ Health 2011;10:92.
31. Lercher P, Botteldooren D, Widmann U, Uhrner U, Kammeringer E. Cardiovascular effects of environmental noise: Research in Austria. Noise Health 2011;13:234-50.
32. Selander J, Nilsson ME, Bluhm G, Rosenlund M, Lindqvist M, Nise G, *et al*. Long-term exposure to road traffic noise and myocardial infarction. Epidemiology 2009;20:272-9.
33. Niemann H, Bonnefoy X, Braubach M, Hecht K, Maschke C, Rodrigues C, *et al*. Noise-induced annoyance and morbidity results from the pan-European LARES study. Noise Health 2006;8:63-79.
34. Evans GW, Lercher P, Meis M, Ising H, Kofler WW. Community noise exposure and stress in children. J Acoust Soc Am 2001;109:1023-7.
35. Regecová V, Kellerová E. Effects of urban noise pollution on blood pressure and heart rate in preschool children. J Hypertens 1995;13:405-12.
36. Stansfeld SA, Berglund B, Clark C, Lopez-Barrio I, Fischer P, Ohrström E, *et al*. RANCH study team. Aircraft and road traffic noise and children's cognition and health: Across-national study. Lancet. 2005;365:1942-9.
37. National Programme for Prevention and Control of Deafness (NPPCD). 2011. Available from: http://www.pipnrhm-mohfw.nic.in/index_files/non_high_focus_large/gujarat/05.%20Chapter%204/4.D%20DCP/9.pdf. [Last accessed 2011 Dec 8].
38. AERB Safety Guidelines. GUIDELINES NO. AERB/SG/IS-3. Personal Protective Equipment. Atomic Energy Regulatory Board. Government of India. January 2004. Available from: http://www.aerb.gov.in/t/publications/codesguides/sg-is- 03.pdf. [Last accessed on 2011 Dec 8].
39. Bistrup ML. Prevention of adverse effects of noise on children. Noise Health 2003;5:59-64.
40. Pathak V, Tripathi BD, Mishra VK. Dynamics of traffic noise in a tropical city Varanasi and its abatement through vegetation. Environ Monit Assess 2008;146:67-75.
41. Samara T, Tsitsoni T. Road traffic noise reduction by vegetation in the ring road of a big city. In: Proceedings of the International Conference on Environmental Management, Engineering, Planning and Economics; 2007. p. 2591-6. Available from http://users.auth.gr/tsitsoni/files/gr/10.pdf. [Last accessed on 2012 Dec 8].
42. Moudon AV. Real noise from the urban environment: How ambient community noise affects health and what can be done about it. Am J Prev Med 2009;37:167-71.

How to cite this article: Jamir L, Nongkynrih B, Gupta SK. Community noise pollution in urban India: Need for public health action. Indian J Community Med 2014;39:8-12.

Source of Support: Nil, **Conflict of Interest:** None declared.