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Impact of odd - even operation on noise pollution in delhi: a soundmeter app based study

Abstract

Background: Road traffic noise is one of the major environmental concerns in India. Delhi stands second in noise pollution ranking by Central Pollution Control Board, New Delhi (CPCB). Road traffic noise is characterized by relatively low levels per event and high numbers, while air and rail traffic are characterized by high levels per event and low numbers. Delhi government has implemented odd-even rule on four wheelers for 15days on trial bases in the territory of Delhi.

Objective: In the current study we have measured the ambient noise levels by using soundmeter app through smart phone at five randomly selected traffic locations in Delhi during odd-even rule implementation(phase A) and without odd-even rule implementation(phase B).

Results: Results of this study revealed that at all the five locations measured average ambient noise levels are more than the prescribed average limit by Central Pollution Control Board (CPCB), New Delhi. The outcome of the present study also showed no statistically significant difference in average ambient noise levels during Phase A and Phase B.

Conclusion: Present study showed no reduction in noise pollution even after implementation of odd-even rule. The outcome of the study also revealed noise pollution more than prescribed average limit in Delhi, which is a matter of urgent concern.

Keywords: traffic noise, noise pollution, environmental noise

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Abbreviations: GPS, global positioning system; DB, decibels; SPSS, statistical package for the social sciences; SD, standard deviation; CPCB, central pollution control board; WHO, world health organization

Introduction

Noise is that unpleasant, disturbing and redundant sound that ought to be avoided due to its adverse auditory and non auditory effects like hearing loss and stress respectively. According to the WHO guidelines (2009), adverse health effects of noise are observed at the level above 40dB such as sleep disturbance, & environmental insomnia and above 55dB the cardiovascular effects become the main community health concern, which are likely to be less dependent on the nature of the noise.[1] Continuous exposure to the noise levels exceeding the prescribed limits may adversely affect psycho-physiological health. Noise pollution is one of the major environmental concerns in India today. Road traffic is the most widespread cause of noise all over the world and the most prevalent source of annoyance and interference we all are subjected to some form of loud noises for a substantial amount of time, during the day. Indian metropolitan cities have higher noise pollution levels compared to other cities. According to the Central Pollution Control Board report (March, 2011), Mumbai was the nosiest metro city of India followed by Delhi, Chennai and Bangalore. The level of noise produced in Delhi has been stated dangerous and acoustically traumatic leading to permanent hearing loss in citizens 15years earlier than expected. A recent study showed that not a single place of Delhi qualified the Central Pollution Control Board's standards of noise control.[2] The Road traffic noise depends on several factors; some of them are condition of vehicles and speed of the vehicles traffic flow, composition (% HGVs), road gradient and road surface characteristics. The major sources of noise in automobiles are intake, engine, exhaust, and fan, and tires at high speed. The noise output of all components increases with speed. Trucks are characteristically noisiest followed by buses and motorcycles while cars are the quietest. The association of cars to the overall traffic noise level is however great because of their large numbers (about 80% of the road traffic). For lower speeds, below 40-50km/h, engine noise including exhaust and intake noise dominates for cars. For higher speeds, above 70km/h, tyre-road noise dominates the car exterior noise generation. For heavier vehicles the engine noise is dominant under most conditions.[3] Exterior road traffic noise results from the combined contributions from a large number of different vehicles. Vehicular Noise pollution is directly proportional to the volume of vehicles. The noise from a flow of traffic at a reception point at any one instant is an aggregation of noise from each of many vehicles at various distances. Increasing of population is increasing of vehicles and hence increasing of Noise pollution. The population of Delhi is 18,686,902 and number of vehicles registered are 96, 34,976 in 2016.

The second phase Odd-even rule was implemented in Delhi from 15th April 2016 to 30th April 2016. Under the purview of the odd even rule, non-transport four-wheeled vehicles having registration number ending with odd digits would be prohibited on even dates of the month of April. On the other hand, plying of non-transport four-wheeled vehicles having registration number ending with even digit would be prohibited on odd dates of the month of April. The rule was applicable from 8AM to 8PM. Specialized instrumentation is required for the occupational noise exposure assessments such as noise dosimeters or sound level meters. Smartphones have evolved into powerful computing machines with exceptional capabilities: Most now have built-in sensors such as microphones, cameras, global positioning system (GPS) receiver, accelerometers, gyroscopes, and proximity and light sensors. Smartphone developers now offer many

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sound measurement applications (apps) using the devices 'built-in microphone or through an external microphone for more sophisticated apps.[4]

Kardus & Shaw[4] in a study showed that certain sound measurement apps for Apple smartphones and tablets may be considered accurate and reliable to be used to assess occupational noise exposures.[4] The Sound Meter app developed by Faber Acoustical measures the minimum, mean, and maximum ambient sound levels in decibels (dB). This app had the best agreement, in A-weighted sound levels, with a mean difference of -0.52dB (A) from the reference values. The evidence suggests that for A-weighted data, Sound Meter is the app best suited for occupational and general purpose noise measurements. In addition to having the smallest mean difference for the A-weighted data, Sound Meter had the narrowest distribution of differences. Recently many studies have been conducted by the researchers to see the impact of odd-even rule implication on air pollution control. There is also a need to evaluate the efficacy of such traffic rule implication on noise pollution control in Delhi. To compare the road traffic noise pollution during and in absence of odd-even operation in Delhi.

Materials and methods

The objective of this study was to compare the road traffic noise pollution levels in Delhi during and after the Odd-even rule implementation. Sound Meter App was installed in Samsung Galaxy on 5 Smartphone and the output of the same was validated using a calibrated sound field audiometer (Harps Inventis) with sound field speakers (JBL Professional LSR 2300). The azimuth of the loudspeaker placement was 0 degree at a distance 6inches from the smartphone microphone. Warble tone, narrow band noise and wide band noise were used as the stimulus, presented through the Pure tone audiometer to validate Soundmeter app output. Recording of noise levels were done during day time at traffic signals at selected sites in Delhi. The study was conducted in two stages. In stage 1 selection and validation of sound meter app was done. In stage 2, data collection was carried out by two audiologists at randomly selected heavy traffic points.

Stage 1: Selection and validation of sound meter app

The Sound meter APP (Smart Tools co.) with customer satisfaction rating (4.2) was installed through Google Play Store (mobile app) in Samsung Galaxy on 5 Smartphone. The Sound meter app has been calibrated by the manufacturer in many android devices with the actual sound level meter with dB(A).The Sound meter app has following features: Integrated Sound Meter and Vibrometer Statistic , A/C/SPL weighting, Leq, Internal/external microphone , calibration, menu with saving log data, CSV file exporting, Level notification, Line-chart duration. Validation of the Sound meter app output was done in the sound treated audiometry room. The Samsung Galaxy on 5smartphone was kept at 0 degree azimuth, near the free field speaker (JBL Professional LSR 2300).

Stage-2: Recording of traffic noise levels at randomly selected heavy traffic points at Delhi

This stage of the study is further comprised of two phases i.e. phase A and phase B. In phase A, data collection was done during odd-even rule implementation. In phase B, data collection was done on days with no odd-even rule implementation. In each phase the traffic noise levels recordings were perpetrated in three trials via sound meter app during day time (afternoon, 12.30pm) at preselected locations in Delhi. The randomly selected locations were as follows: Hauz Khas, Vasant Vihar, AIIMS, Karol Bagh and Kashmere Gate.

Results and discussion

The data collected from the selected traffic locations were subjected to statistical analysis using Statistical Package for the Social Sciences (SPSS) version 16.0 software. The following statistical analyses were carried out on the data. Descriptive statistics was obtained to get mean and standard deviation values for the ambient noise levels on sound meter app studied for all the selected locations. Paired t-test was carried out to compare the ambient noise levels obtained in Phase A and Phase B.

Phase A

The mean, standard deviation (SD) values of the recorded ambient noise levels obtained in Phase A of the study (Table 1).

Table 1 Mean and Standard Deviation (SD) Values of Recorded Ambient Noise levels Obtained in Phase A

Location	Mean Ambient Noise Level dB(A)	SD
AIIMS	86.33	2.51
Vasant Vihar (VV)	79	2.64
Hauz Khas (HK)	82.66	1.52
Kashmere Gate (KG)	80.3	1.52
Karol Bagh (KB)	88	1.73

Phase B

(Table 2) Mean and Standard Deviation (SD) Values of Recorded Ambient Noise levels Obtained in Phase B. (Table 3) Mean and Standard Deviation (SD) Values of Recorded Mean Ambient Noise levels Obtained in Delhi during Phase A and B.

Table 2 Mean and Standard Deviation (SD) Values of Recorded Ambient Noise levels Obtained in Phase B

Location	Mean Ambient Noise Level dB(A)	SD
AIIMS	84.66	3.21
Vasant Vihar (VV)	80	2
Hauz Khas (HK)	84	3.6
Kashmere Gate (KG)	84	3.6
Karol Bagh (KB)	82	2

Paired t-test was done to see if there were any significant difference in the obtained noise levels during phase A and Phase B. Results obtained from Paired t-test shows that there was no statistically significant difference between Phase A and B, with p-value = 0.95. Suggesting that, there was no effect of odd-even rule implementation on noise pollution control in Delhi. This might be due to no apparent change in the number of vehicles plying on the road during both phases. The other reason could be that odd-even rule was only applied for four wheelers. Currently, 96,34,976 vehicles are registered in Delhi (Delhi Government report), out of these nine million registered vehicles only 32.51% are four wheelers and 64% vehicles plying in Delhi are two wheelers and later is the major source of road traffic noise pollution. Motor cycles and scooters, are generally nosier as compared to passenger cars.[5] Odd-even rule was not applicable on public transports like CNG-driven buses, taxis and auto-rickshaws can be the reason of no significant difference between phase A and phase B. Also Delhi metro frequency, numbers and bogies was increased during this period. The odd-even rule was only implemented on 32.51% of the total vehicles in Delhi. The number of vehicles plying on the road during that period was sufficient enough to produce the noise level above the prescribed limits in Delhi.

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Table 3 Mean and Standard Deviation (SD) Values of Recorded Mean Ambient Noise levels Obtained in Delhi during Phase A and B

Phase	Mean Ambient Noise Level dB(A)	SD
A	83.26	3.95
B	83.13	2.95

At all the five locations measured average ambient noise levels are more than the prescribed average limit by Central Pollution Control Board (CPCB), New Delhi is the other major finding of the current study. Similar to noise pollution, air pollution is also a measure concern in Delhi. Rizwan, et al.,[6] in 2013 reported that Vehicular emissions and industrial activities were found to be associated with indoor as well as outdoor air pollution in Delhi.[6] Kumar & Foster[7] in 2009 stated that air pollution levels in Delhi and its surroundings were significantly higher than that recommended by the World Health Organization (WHO). The finding of the present study showed the urgent need of noise pollution control measures in Delhi. The government should take proper action to control noise pollution in Delhi for better quality of life among citizens of Delhi. Similar to odd-even rule, government should implement other rule to control noise and air pollution in Delhi.

Conclusion

The outcome of the current study showed no statistically significant difference between noise level in Phase A (with odd-even rule) and B (without odd-even rule). The finding of the present study also revealed that ambient noise levels are more than the prescribed average limit by Central Pollution Control Board (CPCB), New Delhi.

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Conflicts of interest

Author declares there are no conflicts of intertest.

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