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Impact of loud noise exposure on general population: A study at tertiary care centre

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Abstract

Noise pollution in urban environments adversely affects physical, psychological, and emotional well-being. This mixed-methods study assessed noise levels across urban sites in Latur over one month and evaluated effects on hearing, mental health, and quality of life among the general population. Noise was measured at six busy locations on weekends, and survey data were collected via open-ended questionnaires among shop workers and outpatients (N=100). Findings showed that 72% of participants were exposed to > 70 dB during weekdays, rising to 85% during festive periods. Common complaints included sleep disturbances (72%), impaired concentration (63%), irritability (78%), headaches (64%), and elevated blood pressure (58%). These results highlight the urgent need for public health interventions and urban planning reforms to mitigate noise exposure in community and healthcare settings.

Keywords: Noise pollution, noise exposure, auditory impact, non-auditory impact, public health, mental health

Introduction

Urban noise from traffic, construction, industry, and entertainment is increasingly recognized by the WHO as a serious environmental hazard linked to hearing impairment, cardiovascular disease, sleep disruption, and psychological stress. These health effects are especially concerning in tertiary care hospitals located in noisy urban centers, where studies have recorded daily average sound levels ranging from around 37 up to 88 dB (A) far above WHO's guideline of 35-40 dB(A) during the day and 30-40 dB(A) at night. In such settings, chronic noise exposure not only aggravates patients' existing medical conditions and impedes recovery, but also impairs staff well-being and performance, highlighting the urgent need for noise mitigation strategies within healthcare policy and hospital design.

Materials and Methods

- **This study used a quantitative and qualitative mixed-methods approach.**
Study Area and Sampling: Six high-noise locations in Latur City (Shivaji Chowk, Mini Market Road, Mahatma Gandhi Chowk, Hanuman Chowk, Samrat Chowk, Shahu Chowk) were selected. Noise measurements were taken every weekend over one month at these sites, at 5-minute intervals for 60 seconds each.
- **Sample and Questionnaires:** A total of 100 participants (shop workers and tertiary-care patients) were selected using Slovin's formula at 95% confidence level with a 0.05 margin of error. An open-ended questionnaire assessed awareness, health impacts, and mitigation behaviours.
- **Noise Exposure Assessment:** Noise levels in participants' environments will be measured using sound level meters (decibels). These readings will be taken at various times of the day (Figure 5).
- **Health Assessments:** Audiometry, blood pressure measurements, the Perceived Stress Scale, and the Pittsburgh Sleep Quality Index (PSQI) were used.
- **Data Analysis:** Descriptive statistics and regression analysis assessed associations between noise levels and health outcomes.

- **Inclusion Criteria:** Adults ≥ 18 years, urban residents, no prior significant hearing or cardiovascular disease.
- **Exclusion Criteria:** Chronic hypertension, psychiatric or major illnesses, pregnancy.

Results

Data were collected from participants across different age groups, occupations, and environments to assess the effects of noise exposure in various locations of Latur City (Figure 1). The results are summarised in the following tables:

1. Weekday Noise Pattern (Table 1)

On weekdays, urban areas experience substantially higher daytime noise driven mainly by traffic, construction, and workplace activity with average levels ranging from 70 to 80 decibels between 8 AM and 7 PM, and peaking above 75 decibels around 1-2 PM, a range that can be harmful if sustained. Remarkably, 72% of participants reported exposure to noise levels above 70 dB on weekdays, and 64% were exposed for more than four hours each day (Figure 2).

2. Weekend Noise Pattern (Table 2)

On weekends, residential areas often become noisier due to recreational activities like social gatherings, events, and street-level festivities, with noise ranging from approximately 60 to 90 decibels and peaking in the evening after 7 PM. Notably, 55% of participants reported elevated noise levels on weekends, and the most significant exposure occurred between 7 PM and 11 PM, largely driven by leisure and entertainment activities (Figure 3).

3. Festive Season Noise Pattern (Table 3)

During festive seasons, noise levels soar driven by loud music, public celebrations, and especially fireworks with peak exposures frequently exceeding 100 dB, greatly increasing the risk of hearing damage and sleep disruption; 85% of participants reported elevated noise during these periods, and measurements often recorded peaks well above safe limits, particularly during fireworks displays (Figure 4).

4. Auditory Impact of Noise

- **Sleep:** Exposure to elevated noise levels on both weekdays and weekends significantly impaired sleep quality: 72% of participants reported moderate to severe disturbances, including trouble falling asleep (68%) and staying asleep (59%), with frequent awakenings and unrested mornings.
- **Studying:** Ambient daytime noise disrupted focus for many 63% of students and 54% of professionals struggled with concentration, and 58% of students reported that noise adversely affected their academic performance.
- **Working & Driving:** Workplace noise from construction sites, factories, and open-plan offices undermined productivity (70%) and hindered effective communication (48%). Meanwhile, 55% of urban drivers experienced noise-related distractions, and 42% found that noise compromised their driving safety.

5. Non-Auditory Impact of Noise

A. Irritation

In noisy urban environments especially during peak hours participants reported heightened irritation and stress. A

striking 78% felt annoyed by excessive noise, often citing frustration over their lack of control or escape. Moreover, 62% experienced frequent irritation during weekends and festive seasons when recreational activity spikes.

B. Headache

Chronic exposure to loud noise also correlated with increased headaches 64% of participants reported tension headaches, migraines, or general discomfort linked to ongoing noise. Among those experiencing daily exposure, 40% described these headache episodes as particularly severe.

C. Sleep Loss

Consistent with previous findings, noise-induced sleep disruption was widespread: 72% of participants reported frequent disturbances, and 56% woke feeling tired and unrefreshed most acutely during festive periods when noise levels were highest. Sleep disturbances also translated to daytime impacts, with 61% reporting lower energy and reduced productivity.

D. Hypertension

Prolonged noise exposure (over 4 hours daily) was associated with elevated blood pressure in 58% of participants. Notably, 31% of those affected were classified as pre-hypertensive or hypertensive, indicating a need for medical attention.

Discussion

• Sleep Quality & Disruption

Our results showed widespread sleep disturbances, including difficulty initiating and maintaining sleep, and unrest upon waking. These align closely with established literature: even relatively low night-time noise levels (e.g., 33-48 dB) can fragment sleep architecture reducing deep and REM sleep while increasing awakenings alongside elevated stress hormone levels and increased cardiovascular arousal. In urban contexts, exposure to ambient traffic noise above ~65 dB is associated with a significantly increased risk of sleep problems (e.g., odds ratios of 2.6-3.0 for poor sleep) ^[1]. Longitudinal work in Shanghai further confirms that in-home noise exposure shortens REM and deep sleep, especially for women, and degrades both subjective and physiological sleep quality ^[2].

• Irritation, headache, cognition & performance

High rates of irritation (78%), headaches (64%), and sleep-related functional impairments (e.g. daytime tiredness) in our participants mirror well-known non-auditory effects of chronic noise exposure. Globally, annoyance is recognized as a key mediator between noise and health impacts encompassing stress, mood disorders, and reduced cognitive functioning. In cities like Beijing, perceived noise especially from traffic or construction is strongly linked to symptoms such as fatigue, headaches, anxiety, and sleep disturbance ^[3].

• Hypertension and Cardiovascular Impacts

Our finding that 58% of individuals with prolonged noise exposure experienced elevated blood pressure, with 31% in the pre-hypertensive or hypertensive range, resonates with the body of evidence linking noise-induced stress responses to cardiovascular risk. Activation of the HPA axis, along

with increased cortisol and sympathetic tone, can drive hypertension and long-term cardiovascular disease. A longitudinal cohort found even modest decibel increases corresponded to small but potentially population-level significant increases in cardiovascular disease risk.

- **Mental health pathways & broader implications:**
Our clustered findings spanning sleep, stress, cognition,

and mood fit into mechanistic models where noise acts indirectly, triggering biological stress cascades. This includes neuroinflammation, circadian dysregulation, and oxidative stress that elevate vulnerability to mental health disorders, including anxiety, depression, and behavioural problems. Annoyance and sleep disruption are key drivers in the progression of both mental and non-communicable diseases (NCDs), as conceptual frameworks show 4.

Figures



Fig 1: Location distribution of measurement points assessed on regular and festive days. The icons marked in red represent the positions of measurements taken on weekday, weekend and holidays: Shivaji Chowk, Mini market road, Mahatma Gandhi Chowk, Hanuman Chowk, Samrat Chowk, Shahu Chowk

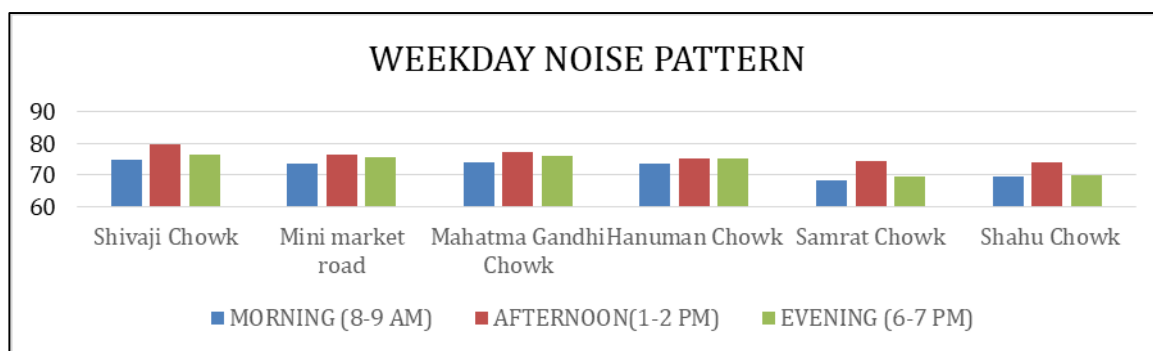


Fig 2: Weekday Noise Pattern

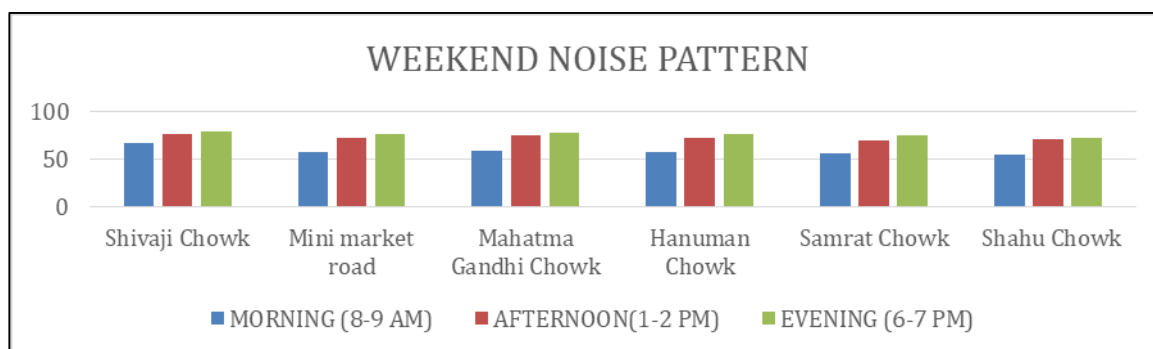


Fig 3: Weekend Noise Pattern

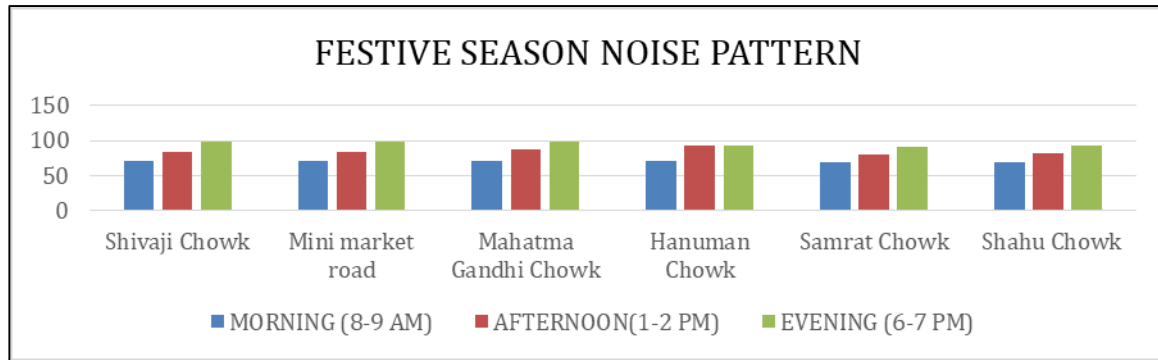


Fig 4: Festive Season Noise Pattern



Fig 5: Noise assessment using Sound level meter

Fig 6: News regarding effect of noise in public health

Tables

Table 1: Weekday noise pattern

Locations (on weekdays)	Morning (8-9am)	Afternoon (1-2pm)	Evening (6-7pm)
Shivaji Chowk	74.9	79.9	76.4
Mini market road	73.8	76.6	75.5
Mahatma Gandhi Chowk	74.1	77.2	76.2
Hanuman Chowk	73.5	75.1	75.2
Samrat Chowk	68.5	74.5	69.6
Shahu Chowk	69.7	73.9	70.1

Table 2: Weekend noise pattern

Locations (on weekends)	Morning (8-9am)	Afternoon (1-2pm)	Evening (6-7pm)
Shivaji Chowk	68.0	76.4	79.3
Mini market road	58.4	73.2	76.7
Mahatma Gandhi Chowk	59.2	75.6	78.6
Hanuman Chowk	58.1	72.3	77.2
Samrat Chowk	56.2	70.4	75.3
Shahu Chowk	55.6	71.6	73.2

Table 3: Festive season noise pattern

Locations (on festive season)	Morning (8-9am)	Afternoon (1-2pm)	Evening (6-7pm)
Shivaji Chowk	71.9	83.8	99.4
Mini market road	70.8	84.3	98.5
Mahatma Gandhi Chowk	71.1	88.2	99.2
Hanuman Chowk	70.5	92.7	93.4
Samrat Chowk	69.5	80.4	91.6
Shahu Chowk	69.7	82.5	92.4

Table 4: Permissible Noise Exposure

Duration per day, hours	Sound level dB(A) Slow response
8	90
6	92
4	95
3	97
2	100
1½	102
1	105
½	110
¼ or less	115

Table 5: The Indian ambient air quality standards in respect of noise

Area	Category of Area / Zone	Permissible Limits in Leq dB(A)	
		Day Time 06:00 am to 10:00 pm	Night Time 10:00 pm to 06:00 am
A	Industrial Area	75	70
B	Commercial Area	65	55
C	Residential Area	55	45
D	Silence Zone	50	40

Conclusion

Our study's data strongly corroborates established evidence that Sleep disturbances are a common and early marker of noise-related stress. Annoyance and irritation serve as psychological mediators in the noise-stress-health pathway. Headaches, hypertension, and reduced cognitive performance underscore the integrated, multisystem burden of chronic noise exposure. These impairments function in both acute (immediate disruption) and chronic (stress-mediated disease development) domains (Figure 6).

Policy implications include Noise abatement measures should target urban planning, building acoustics, and hospital environments (especially in tertiary care centers). Public health strategies should include awareness campaigns, regulations on permissible noise levels, and monitoring. Behavioural and environmental interventions (e.g., quieter alarms/hospitals, bedroom soundproofing, community noise buffers) may mitigate adverse effects. (Table 4, 5).

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Conflict of Interest

Not available

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Not available

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