

# QUALITATIVE ASSESSMENT OF COMMUNITY RESPONSE TO ANNOYANCE DUE TO TRAFFIC NOISE IN AHMEDABAD CITY

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## ABSTRACT

For formulating and implementing noise policies, it becomes necessary to assess resident's responses and reactions to community noise. For valid comparison of socio acoustic survey results, a harmonized questionnaire has been designed and developed in accordance with guidelines of International Commission on Biological Effects of Noise (ICBEN) for Ahmedabad city in the Gujarat state of India. The survey was performed through online platforms and through personal interviews. Total 396 responses were analysed for estimating resident's exposure and annoyance to traffic noise. The result of study showed that the percentage of highly annoyed people at home was less than moderately annoyed respondents. Lower responses were observed for highly annoyed as well as for moderately annoyed in the numeric scale compared to the verbal scale for given exposure category. However, the results showed that 55.1 % people are highly annoyed when they are commuting.

**Keywords:** *annoyance, ICBEN, questionnaire, traffic noise*

## INTRODUCTION

Noise defined as unwanted sound is an environmental pollution generated due to anthropogenic activities. Noise emitted from all sources except industrial places is community noise. Main sources of community noise are transportation activities (road, rail, and air), construction activities and public works; home appliances, office machineries, sound systems, and neighbours are main sources of indoor noise. Though noise pollution is a crucial global menace for human

population, control of this noise pollution has been impeded by deficient knowledge of its effect on humans in contrast to other environmental pollutions [1]. Exposure to noise of higher frequency and duration can induce hearing impairment. Short term but frequently serious adverse effects due to noise include interference with speech intelligibility, sleep disturbance, physiological and psychological effects, reduced performance of cognitive tasks, social and behavioural effects as well as annoyance. Parameters such as effect of annoyance on behaviour,

communication interference, sleep disturbance and hearing impairment can be used to frame guidance for control measurements [1 - 4]. Annoyance is widespread and a common response of population which is exposed to the community noise. Noise annoyance generated from noise interference adversely affects the daily activities that can further trigger negative responses and stress-related symptoms. Annoyance adds up to the diseases from environmental noises as it is observed that a high number of people suffer from deteriorating health when exposed to it [4 - 6]. Most references discuss the relation of annoyance or sleep disturbances that are mostly concerns with transportation noise level [7, 8]. Noise annoyance can also be self-reported by an exposed person by providing answer to the questionnaire framed just for this purpose.

A sample survey of 150 respondents in Delhi (India) revealed automobiles and public address system as a major source of noise pollution that eventually leads to reduced efficiency and psycho-somatic effects [9]. In a review of a social survey for community response, it was emphasized that more social surveys need to be conducted in order to frame new policies to control noise pollution. Frequent honking of vehicle was reported as the main cause for road traffic noise [10]. In Porto (Portugal), the resultant annoyance established in a conducted survey revealed high dissatisfaction and 44 % of population were reported to be living in an extremely annoying condition [11], whereas around 65 % of respondents were found to be annoyed to some extent by one or more noise sources in Norway [12]. The study conducted for cities of Vietnam stated that people can tolerate 5 to 10 dB higher noise level coming from road traffic and its response overestimated the occurrence of annoyance in the country [13]. A survey carried out in the south of Sweden reported that the annoyance due to road traffic noise at least once a week was significantly more prevalent. Although, the differing results of two surveys are believed to have been caused by the varying scales used in surveys [14]. Ahmedabad city is one of the fastest growing cities in India, witnessing significant increase

in background noise levels. This requires a study of the effects of noise on residents. It is not known that such socio acoustic survey has been conducted for Ahmedabad city of India so far. This paper attempts to develop a questionnaire to determine the kind of survey format that can be used more effectively. The questions developed and framed are focused on performing assessment of noise annoyance by means of socio-acoustic survey based on ICBEN guidelines.

## METHODS

The study was divided in two phases. In the first phase of this present study, a balanced questionnaire was framed and survey was conducted and in second phase responses were analysed.

### Questionnaire development

Objective of developing a survey questionnaire is to capitulate widely accepted measures of comparison for reaction and responses to traffic noise. For the purpose of noise survey, the ICBEN team have recommended the use of a pair of multipurpose questions. ICBEN have designed the questions that are meeting characteristics to permit rational comparison of the results, and can be adopted internationally. The recommended survey is suitable for all modes of questionnaire administration methods and the results can be compatible to interpretation by residents who are giving response and reactions and policy or decision makers as well as researchers. In their final recommendation, the ICBEN team suggested two reaction questions. (1) The 5-point verbal scale question is: *"Thinking about the last (..12 months or so..), when you are here at home, how much does noise from (..noise source..) bother, disturb, or annoy you; Extremely, Very, Moderately, Slightly or Not at all?"* (2) The (0 - 10) point numeric scale question is *"....what number from zero to ten best shows how much you are bothered, disturbed, or annoyed by (.. source..) noise?"* [15].

The questionnaire survey for present research was entitled "Noise Exposure Questionnaire". The survey consisted of initial general information and a total of nine situational and attitudinal variant of questions titled "Living Environment and Noise". In the header of the questionnaire, with a brief goal of the survey, respondents were specifically asked to answer the questions sequentially. In the general information section, demographic variables, such as gender, age, education, type of dwelling, location of residence, length of residence, and general mode of transportation between home and workplace were included.

For assessing annoyance due to traffic noise when respondents are at home, the 5-point verbal scale and 0 - 10 point numeric scale questions were asked in the beginning of the survey as recommended by ICBEN. Additionally, likewise other megacities, residents of Ahmedabad (Gujarat, India) also spend considerable time in commuting from home to workplace on busy traffic corridors, which are more congested during peak hours. To assess their noise exposure while travelling, 11-point numeric scale question was asked for the level of being bothered, disturbed or annoyed by traffic noise when travelling from workplace to home and vice versa. Furthermore, respondents were questioned in the 5-point verbal scale about how often they are disturbed by road traffic noise for activities such as reading, thinking, concentration, sociability, leisure or routine activities and sleep. Information regarding kind of vehicles disturbed or annoyed them in particular and their willingness to pay for less noisy area was collected in concluding part of the survey. On 5-point scale, top two points are combined to measure "highly annoyed" [15] and #8, #9 and #10 of unipolar scale are estimated as "highly annoyed" in analysis [16].

To get response for the question "Thinking about the last 12 months or so when you are at home, how much does noise from road traffic bother, disturb, or annoy you?", 5-point scale (a visual display of vertically arranged response alternatives was incorporated as shown in Figure 1) and 0 - 10 scale (presented

as equally divided horizontal line, as shown in Figure 2) were used for online survey.

Figure 1. Verbal scale for annoyance question

Figure 2. Numeric scale for annoyance question

### Mode of survey administration

The present study has been performed for Ahmedabad city in Gujarat state of India, which have latitude and longitude coordinates 23.033863 and 72.585022 respectively. Ahmedabad city is the 7<sup>th</sup> largest metropolis in India, covering a geographical area of approx. 464 km<sup>2</sup>. The questionnaire was conducted as an online survey, as well as by means of interviewing persons, keeping all the details mentioned above for Ahmedabad city. Online surveys help in distribution process and collection of data and are less time-consuming and easy for respondents to understand. Responses received through online survey were also from places that do not belong to the Ahmedabad study area. After dropping responses that are not from the selected study area, the total of 396 responses were filtered and analysed.

### RESULTS AND DISCUSSION

Demographic variables from general information sections are given in Table 1. These data are used to analyse respondents' annoyance due to traffic noise with respect to different variables. Major respondents (74.5

%) were less than 40 years old and 79 % of them had university level of education and higher.

Table 1. Demographic details of respondents (study area: Ahmedabad city)

Variables	Categories	% (n=396)
Gender	Male	71.97
	Female	28.03
Age (years)	18 to 25	40.2
	26 to 40	34.3
	41 to 50	12.4
	More than 50	13.1
Education	Post graduate and higher	38.1
	Graduate	40.9
	HSSC (Higher Secondary School Certificate) and more	19.0
	SSC (Secondary School Certificate) or less	2.0
Mode of transport, (Home to workplace)	Two-wheeler	46.0
	Auto rickshaw	3.3
	Car	33.1
	Bus	15.4
	Other	2.2
Category of dwelling	Row house	14.2
	Detached house	18.9
	Apartment (all floors)	66.9
	Apartment (ground floor)	5.8
	Apartment (first floor)	10.1
	Apartment (second floor)	14.1
	Apartment (third floor or above)	36.9

On the 5-point verbal scale, the percentage of people highly annoyed (% HA) with traffic noise when they are at home is 27.7 % (combined "Extremely" (8.3 %) and "Very" (19.4 %)); the moderately and slightly annoyed together account for 61.7 %, as shown in Figure 3. On the numeric scale, percentage of highly annoyed people is 21.5 %, while the range between 3 and 8 accounts for 50.7 %, as shown in Figure 4. Lower responses were observed for high annoyance as well as for moderately annoyed in numeric scale compared to verbal scale for given exposure category.

Percentage of respondents highly annoyed by the traffic noise when at home revealed a notable shift to a lower value, which is found to be in contradiction to the study carried out in European and South American countries [1, 11, 13].

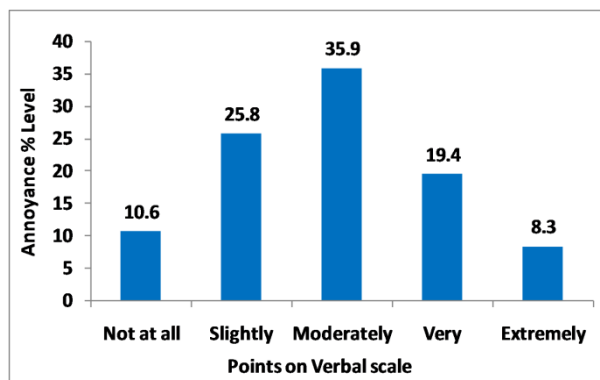


Figure 3. Noise annoyance percentage levels on the 5-point verbal scale

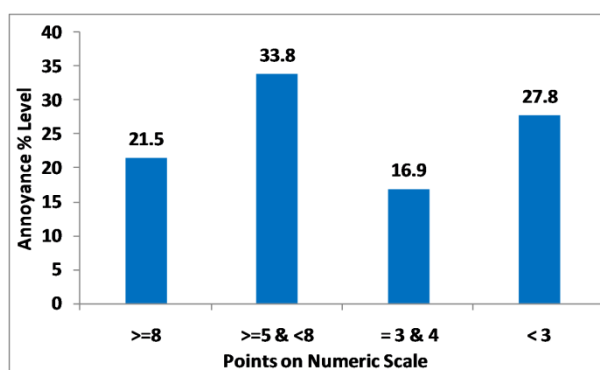


Figure 4. Noise annoyance percentage levels on the numeric scale

Two-wheelers (motorbikes) are used by 46 % of respondents, and over 33 % of the respondents drove cars. Figure 5 illustrates responses to the question of "Thinking about the last 12 months or so, what number from zero to ten best shows how much you are bothered, disturbed, or annoyed by traffic noise when you are travelling from your workplace to your home?"

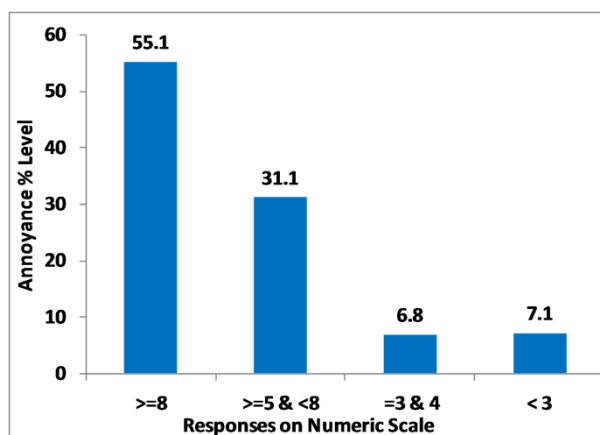


Figure 5. Noise annoyance percentage levels while travelling, on the numeric scale

Many researchers have revealed that the noise from road-tire interaction becomes pronounced at a higher speed of vehicles. In a city like Ahmedabad, enormous density of vehicles on roads during peak hours creates prevalent recurrent traffic jam at road junctions and traffic signals. At such scenario, engine and exhaust noise emitted due to frequent vehicle acceleration-deceleration and honking of impatient drivers becomes predominant and contributes to high noise occurrences. It is a complex task to assess or quantify reaction of citizens to noise because their responses may often be influenced by various other factors. These factors could be attitude to noise, satisfaction, expectation or comparison of noise levels too. In a study carried out for Ahmedabad city, noise level of over 70 dB(A) was reported during morning and evening peak hours on busy traffic corridors [17]. City's residents are exposed to higher and prominent noise levels for considerable time outside their homes and specifically during commuting, therefore they subjectively feel less noisiness when at home.

This rationale may have led them to respond less annoyed at home and almost twice higher while commuting.

To investigate annoyance levels due to traffic noise in different types and levels of home, dwelling category details were collected through questions in general information section. Table 2 shows the annoyance level for different types of dwellings based on the verbal scale. People living in the second floor or above in an apartment are less extremely annoyed in comparison to rest types of dwelling owing to noise attenuation.

No connection was found between gender and noise annoyance. However, 38.4 % of respondents older than 50 years are highly annoyed by the traffic noise, while in the case of relatively young people aged between 18 and 25 years this percentage is considerably lower (23.9 %). Table 3 shows noise annoyance reported on the verbal scale by different age groups.

Table 2. Noise annoyance for different category of dwellings

Category	Types of dwellings	Noise annoyance on the verbal scale				
		Not at all	Slightly	Moderately	Very	Extremely
Individual house	Row house	14.29 %	28.57 %	32.14 %	12.50 %	12.50 %
	Detached house	9.33 %	25.33 %	34.67 %	21.33 %	9.33 %
Apartment	Ground floor	8.7 %	30.4 %	26.1 %	21.7 %	13.0 %
	First floor	5.0 %	22.5 %	40.0 %	20.0 %	12.5 %
	Second floor	8.9 %	19.6 %	46.4 %	19.6 %	5.4 %
	Third floor or above	12.3 %	27.4 %	34.2 %	20.5 %	5.5 %

Table 3. Noise annoyance for different age group on verbal scale

Age in years	Noise annoyance on verbal scale				
	Not at all	Slightly	Moderately	Very	Extremely
18 to 25	10.1 %	32.7 %	33.3 %	17.0 %	6.9 %
25 to 40	12.5 %	22.8 %	36.0 %	19.1 %	9.6 %
40 to 50	12.2 %	20.4 %	40.8 %	20.4 %	6.1 %
> 50	5.8 %	17.3 %	38.5 %	26.9 %	11.5 %



A question in tabular form was asked to assess how much respondents are annoyed or disturbed by road traffic noise in various routine activities. Figure 6 shows that when being outside of their home 60.9 % of respondents were highly annoyed, while for other activities such as reading / thinking / concentration 35.6 %, for sociability 28.3 %, for sleeping 21.4 % and for watching TV / conversation / phone calls 23.2 % were highly annoyed.

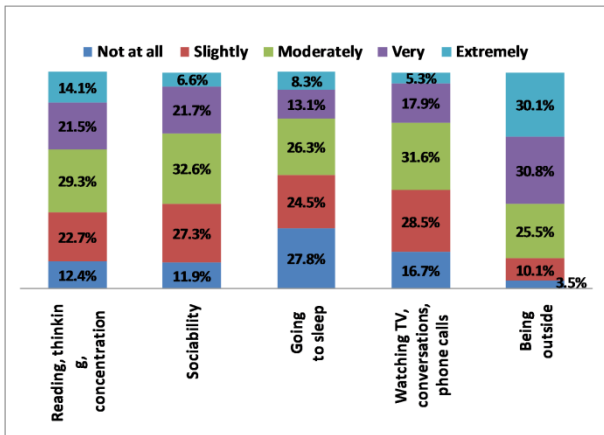


Figure 6. Noise annoyance percentage levels due to traffic noise on verbal scale for different activities

Among the total registered motor vehicles in Ahmedabad, two-wheelers have been predominant with a share of 72 %, whereas buses have a share of 1.6 % [18]. A very small number of buses shows that the bus-based public transport system in the city is insufficient.

In order to investigate which type of vehicle particularly disturbed or annoyed the respondents, they were asked to specify one or more vehicles. Figure 7 shows their reaction, i.e., that 31.4 % of the responses state motorcycles as the cause of their displeasure.

Regarding their willingness to pay for a living in a less noisy area, combining post graduates and higher, graduate and HSC respondents, a total 39.4 % of people revealed their willingness, 13.2 % were unwilling to pay and 45.5 % were unsure (Figure 8).

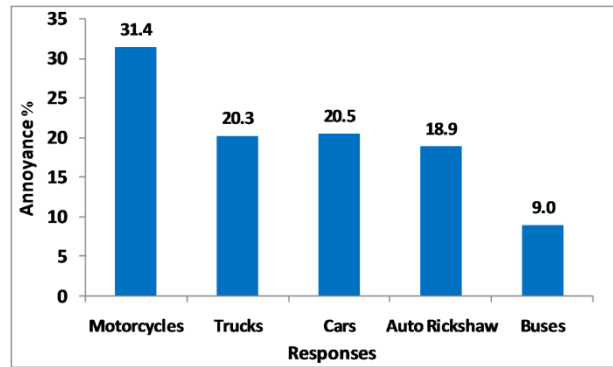


Figure 7. Annoyance associated with different type of vehicles

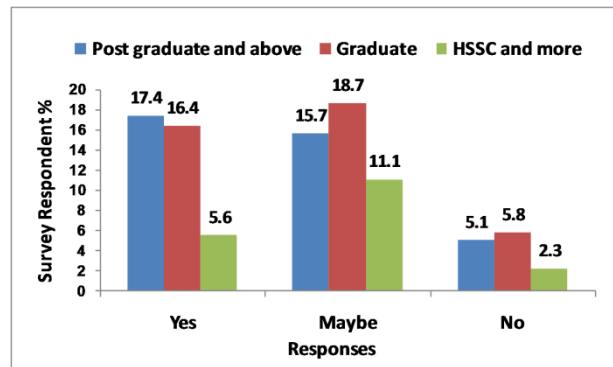


Figure 8. Comparison of education level and willingness to pay for less noisy area

From the data on education levels it can be seen that the majority of respondents (79 %) were educated to graduate level and higher.

## CONCLUSION

This paper has presented a qualitative assessment of annoyance due to traffic noise in Ahmedabad city. A questionnaire that included questions about reaction to noise for different situational and attitudinal variants was developed in accordance with ICBCEN's guidelines. More responses "highly annoyed" were received on the 5-point verbal scale than on the 11-point numeric scale. People reported being more annoyed by the noise while they were outside their homes or while commuting, compared to when they are at home. Percentage of the highly annoyed at home were notably less compared to research conducted in developed countries. Possible reason for this could be their exposure to high

noise levels on busy roads to which they have adapted, resulting in less noise perception while at home. Similar responses to annoyance were found for all genders. Observing different age groups, people over the age of 50 are more annoyed by noise. To mitigate undesirable effects of noise and improve quality of life, policy and decision makers should emphasize the need of proper planning of road infrastructure and enforcement of regulation. In a situation where enhancement of acoustical properties of building is indispensable because of legislation, public participation and self-initiative could play an important role in achieving the goal. It is important to raise awareness in community about the adverse effects of noise annoyance in our daily life.

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