

# Measurement of noise pollution caused by vehicles and the level of annoyance corresponding to it in the residents of Navvab Expressway neighborhood

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## Abstract

Disturbance caused by noise causes malfunctioning, reduction of efficiency and negative impact on personal and social life. The purpose of this study is to measure the amount of sound disturbance caused by vehicles and the amount of disturbance based on the standard (ISO15666-2017) in the residents near the Navvab highway. The relationship between the variables was done using non-parametric tests and analysis of variance, and the data was analyzed with spss21. The equivalent sound level was 61 dB during the day and 53 dB at night, which is more than the permissible limit provided by the country (45-50). Also, there is a significant relationship between noise level and nuisance score.

**Kew Words:** noise annoyance; noise nuisance; vehicle noise; ISO15666

## Introduction

Annoyance caused by noise and feeling uncomfortable causes dysfunction and also reduces people's efficiency and has a negative impact on people's personal and social life. According to statistics published by the European Union, only in this continent, about 108 million people are exposed and the noise caused by road traffic is higher than the standard (above 55 decibels). It is also estimated that the amount of annoyance caused by traffic noise has reached more than 30% [16].

According to the statistics of the United Nations, the lifestyle is changing compared to previous years, and this has led to the expansion of urban life and a sharp increase in the population of cities, the number of vehicles and the resulting traffic, especially in large cities in developing countries. With the increase in the traffic of vehicles, the noise caused by them and as a result the noise annoyance has also increased. Unfortunately, the city of Tehran has also suffered from this big environmental problem and the residents of this city are facing noise pollution caused by vehicles. Noise pollution in addition

to throughout the day, even at night and during rest and sleep, the lives of people, especially in the residential areas adjacent to the main roads and highways of Tehran, has suffered from annoying noise.

In many countries, various standards and guidelines have been developed in order to control exposure to traffic noise and its management, as well as control noise annoyance. For example, in the European Union, Directive 2002/49 EC, related to the assessment and management of noise and environmental noise has been published and the permissible level of noise caused by traffic has been declared in order to control discomfort and noise annoyance [8].

In the country of Iran, the Environmental Protection Organization has developed standards to control the permissible level of noise in residential areas based on the investigations. As seen in Table1, according to the Iranian environmental standard, it is 55 decibels (dba) during the day and 45 decibels (dba) at night for residential areas [10].

Area type	Average night balance (10 pm to 7 am)( Dba) Night LP	Average balance of the day (7 am to 10 pm) (Dba) Day LP
residential area	45	55
Mixed zone (current-residential)	50	60

Commercial-administrative area	55	65
Area of activity (residential-industrial)	60	70
Industrial zone	65	75

**Table 1:** Permissible limit of noise pollution based on the standard of Iran's environmental organization

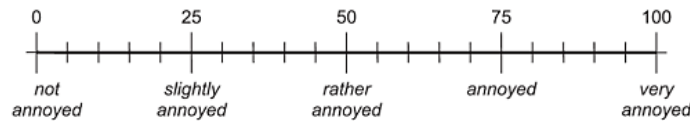
In evaluating the noise caused by vehicles, there are two influential factors, one is measuring the level of noise exposure and comparing it with the standards, and the other is people's understanding of different levels of vehicle noise and the level of noise annoyance caused by it, which is less noticed. Numerous studies have been conducted in the field of noise pollution and the annoyance caused by it in the world, but the country studies in this field are limited and few, and most of the studies are only limited to measuring the level of noise exposure and the amount of annoyance caused by vehicle traffic noise. It has not investigated people, especially in residential areas and at night. The main purpose of this study is to determine the level of exposure to noise caused by the passage of vehicles on Shahid Navvab Safavi highway in the residential area of Navvab b, comparing the results with It is the national standard as well as the assessment of the relationship between the level of noise exposure and the annoyance caused by it all day and night.

**Methods**

The present study is a descriptive-analytical cross-sectional type and was conducted in the spring of 2022 in Navvab b neighborhood of Tehran city, adjacent to Shahid Navvab b Safavi highway. In order to check the level of annoyance of people, a questionnaire including demographic information (age, gender, marital status, education) and level of annoyance was prepared.

By referring to similar studies, the number of samples was determined to be 200, and in order to eliminate incomplete questionnaires, a total of 250 questionnaires were prepared and distributed among the residents. After collecting the data, 203 of the 250 questionnaires were approved. The study used the method recommended by the International Organization for Standardization (ISO 15666-2017) to measure annoyance caused by noise. Based on this exposure standard, the average level during the day (7 am to 10 pm), the average level at night (10 pm to 7 am) and finally the total day and night balance was measured. Also, the maximum noise level during the day and night was also calculated and measured. The used sound meter was manufactured by TES Company, model 1358, which was calibrated before use. Based on the recommendation of ISO organization and Iran environmental organization, audio network A and slow mode (SLOW) were selected for measurement. [1, 3, 4, 5]

The scale of noise annoyance was done using a 4-level verbal annoyance scale. In order to better understand by people and to easily convert it into a percentage, a scale of 0 to 100 was used (a score of zero means "doesn't bother", a score greater than zero to 25 is "slightly annoying", a score greater than 25 to 50 is "moderately annoying", a score greater than 50 to 75 is "annoying", and a score greater than 75 is "very annoying".



**Figure 1:** Noise annoyance scale (NAS) according to the standard (ISO 15666-2017)

Regarding the classification of the level of annoyance, it was decided that according to the studies carried out, including the study of Midma et al., as well as Panovik et al., the rating of annoyance should be such that an annoyance score less than 60 indicates a low level of annoyance and an annoyance score equal to 60 and be considered more indicative of high-level annoyance [14]. Finally, by using non-parametric statistical tests, analysis of variance and Pearson's correlation coefficient, the correlation between the data obtained from voice estimations and the data obtained from self-reporting of individuals was obtained, and the significance level was considered to be 0.05. Data analysis was done with SPSS version 21 statistical software.

**Results**

45% of the participants in the study were women and 55% were men. People in the age range of 30 to 49 years with 36% were the largest age range. 49% of people were single and 51% were married. In order to investigate the relationship between annoyance score and Non-parametric Mann-Whitney and Kruskal-Wallis tests were used for age, sex, marriage, and education variables, and the results show no correlation between age, sex, marriage, and education variables with the annoyance score.

Individual profile	category	Frequency	Percent	P-VALUE *p<0.05
marital status	Single	99	49	0.16
	married	104	51	
gender	Man	112	55	0.3
	Female	91	45	
Age	under 18 years old (children and youth)	43	21	0.7
	19-29 (junior)	57	28	
	30-49 (middle of the year)	73	36	
	50 and above (elderly)	30	15	
Level of Education	High school	85	0.42	0.23
	diploma	35	0.17	
	Associate Degree	40	0.2	
	Bachelor's degree and higher	43	0.21	

**Table 2:** General demographic characteristics of the studied population

The results of measuring the noise caused by the passage of vehicles showed that the average level of traffic noise is unfavorable for the people participating in the research (Table 3). The average noise level equivalent to 61 dB during the day and 53 dB at night was obtained, which indicates

exposure exceeding the permissible limit provided by the Environmental Protection Organization for residential areas, and the level of exposure during the day is 11 dB and at night 8 dB is more than is the limit.

24hour sound level			Sound level at night (10 pm to 7 am)			Sound level during the day (7 am to 10 pm)		
Ave	Max	Min	Ave	Max	Min	Ave	Max	Min
64.1	72	51	53	59	39	61	67	41

**Table 3:** Results of measurement of sound level caused by vehicles on Navvab b highway

In table 4, the percentage and frequency of annoyance scores are presented separately for day, night and 24 hours. As can be seen, the highest frequency of annoyance above 60 was obtained during the night with 71%, and the lowest annoyance above 60 was related to It is 24-hour annoyance with 55% annoyance. Therefore, the perception of annoyance by residents is much higher at night than during the day.

The results of the analysis of variance test between the measured sound level and the annoyance score show a significant relationship between the two variables of the annoyance level and the measured sound level in all three modes of day, night and 24 hours. The test results are in table number 4 and 5 are displayed.

Annoyance	High annoyance (more than 60)		Low annoyance (less than 60)	
	Percent	Frequency	Percent	Frequency
Day	62	126	38	77
the night	71	144	29	59
24 hours	55	112	45	91

**Table 4:** The amount of noise annoyance by number and percentage

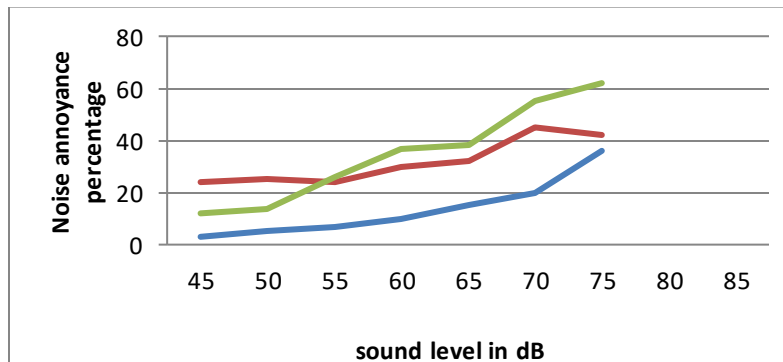
Measured sound level	R	P-VALUE
Daytime noise level (7 am to 10 pm)	0.213	0.006*
Night sound level (10 pm to 7 am)	0.411	0.000*
Total sound level 24 hours a day	0.304	0.003*

**Table 5:** Correlation between the measured sound level and the level of annoyance perceived by people

**Discussion and conclusion**

In order to compare the results of the sound level and the annoyance caused by it, the results of the present study and the results of similar studies,

including the study of Madima in 2007 and the study of Jakojevic in 2009, are drawn in the diagram of Figure 2. [7, 14]



**Figure 2:** Comparison of the relationship between the level of sound level and the percentage of annoyance caused by sound in 3 different studies

In general, by examining the graph, the correlation between the sound level and the annoyance caused by it can be completely confirmed in all 3 studies. Of course, the sound level and also the annoyance score in the studies, although they have a similar trend, but they are different in terms of numerical value. which is caused by various factors, including the average speed of passing vehicles, the number of passing vehicles and also their type. Based on the studies of these factors, it has a significant effect on the level of produced sound and as a result, human perception of the produced sound.

Jahan on the effect of sound level on annoyance showed that in most of these studies, the effect of noise level on increasing annoyance has been confirmed [6, 9, 12, 13, 17, 18].

The results of the current study show that the level of annoyance is high in both time periods measured. The results related to annoyance in the night time period is 71% much higher than the annoyance perceived during the

In the studies that have been conducted inside the country on topics related to noise annoyance, it shows a significant relationship between noise annoyance and the level of exposure to noise. Acceptance indicates the high level of noise annoyance caused by passing vehicles [1]. Also, in a study, Kayani Sadr et al investigated the level of noise pollution in Khorram Abad city and the results presented by them also show the direct effect of vehicle noise on noise annoyance [4]. and colleagues in Tabriz city in 2014, the researchers confirmed the impact of noise caused by the passage of vehicles on health and increasing the level of annoyance.[2] In 1996, during a

research project, Ali Mohammadi and colleagues emphasized the relationship between the level of noise caused by Basij highway traffic and the level of annoyance caused by noise. They announced that the traffic noise has led to disruption in the performance of the residents of the studied area and women are more annoyed. Therefore, it is suggested to take corrective measures in order to provide physical, mental and psychological health.[3]

Considering that the studied area is a residential area, unlike commercial and office areas that are deserted at night, in residential areas, people are constantly present at home to rest at night, and considering the reduction of noise caused by activities daily and normal noises in homes (television, radio, gas stove, etc.) This issue has caused people to be more sensitive to annoying noises. Therefore, the average level at night is more important in residential areas. Therefore, it requires careful consideration in the construction of settlements and goat farms.

In the areas where the highways and the main rivers of the cities are located, care must be taken to maintain the proper distance from the highways in the construction and operation of residential areas, also in the case of residential areas and when expanding roads and streets, this point should be made. should be fully taken into consideration. However, regarding the current conditions and residential places such as the Navvab b neighborhood investigated in this study, considering that the costs incurred in the construction of highways and residential settlements do not allow for destruction or fundamental changes, it can be done using Sound walls were used to reduce the noise caused by highway traffic in order to reduce the amount of noise annoyance caused by traffic and the passage of vehicles.

It is suggested that as a research project in the next studies, the level of noise caused by vehicles in two residential areas adjacent to the main highways of the city, one without a sound barrier and the other with a sound barrier, should be carried out in order to reduce the role of sound barriers. The noise level produced by vehicle traffic and the level of annoyance caused by it should be investigated and compared.

In the studies conducted, many researchers have emphasized the effect of the level of noise and the level of discomfort and irritation, including in the studies

### Appreciation

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