



Assessment of the effects of air and noise pollution in the Sadr highway on sensitive groups of the area using GIS

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Abstract

Air pollution and traffic noise are increasing in developing countries. Surveying the environment and awareness of the concentration of pollutants, as well as awareness of the level of sound that has harmful effects on human health is important in order to take the necessary measures and optimal management decisions and subsequently reducing disease and saving time and money. In this research, air and noise pollution in Sadr highway in Tehran has been studied. Five pollutants of air pollution index including carbon monoxide, nitrous oxide, sulfur dioxide, ozone and suspended particles were measured. Then the rate of air pollution index was determined. The sound level was measured along the highway using a portable sound meter. The results indicate that the rate of air pollution index on Sadr highway is unhealthy for sensitive groups. And the audio level is 80 dB per day and 70 dB at night, which is more than the standard. In this study, the effects of air pollution and noise pollution on children's learning in the area were studied. At the end, there are some ways to reduce air and noise pollution.

1. Introduction

The environmental pollution that is imposed on the Earth and its ecosystems, depending on its impact on the environment, has a different level of attention. Some of these contaminants (such as air pollution) appear more important because of their obviousness and some others (such as noise pollution), regardless of their long-term effects, are in the next category. Air and noise pollution today are the dangers that have been encountered in many cities. However, air and noise pollution caused by interurban roads has grown dramatically with the increase in the number of vehicles and their traffic. Tehran is one of the most polluted cities in the world with excessive air pollution. Control of environmental factors has a key role in promoting human health and environmental pollutants that have a wide range of complexity can put all three physical, mental and social dimensions of human health at risk. Pollution is the entry of new elements and compounds into the environment, as well as changing the ratio of elements and compounds that are involved in the natural structure of the environment. In fact, the addition of any material to some extent changes the physical and chemical properties of clean air. Therefore, such materials are considered as air pollutants. Pollutants are usually classified as substances that have significant effects on humans, animals, plants or substances. Accordingly, almost every natural or artificial material that can be extracted from the air is classified as pollutant. Such materials are solid particles, liquid droplets, gases, or a mixture of these forms. Most air pollution problems relate to the variety of different types of contaminants in various forms [1]. The five air pollutants include carbon monoxide, sulfur dioxide, nitrogen dioxide, ozone and particulates. Particulates have attracted a lot of attention as one of the air

pollutants. This is due to their role in contributing to pollution and health hazards. International statistics of air pollution damage shows that the illnesses caused by it are the fourth highest number of deaths. In Tehran, particulates are known as the main dangers of air pollution. Also, noise pollution is an unwanted sound in the environment or, in other words, it is the uncertain and irregular mix of sounds. In fact, noise or noise pollution can be considered as an unwanted sound, which disturbs relaxation while resting or concentrating people while doing work. Sound measurement unit is in decibel and based on air pressure changes, its value ranges is expressed between zero dB (hearing threshold) up to 130 dB (threshold of deafness) [1]. In most parts of the city of Tehran, the amount of noise pollution around the highways is far exceeded. The following are the negative effects of noise pollution: sleep disorder, nervous discomfort and cardiovascular disorders. In the field of air pollution and noise pollution at the national and international levels, extensive studies have been carried out. Here are some of these studies. Mustafic et al conducted a study to investigate the effects of acute heart disease caused by various air pollutants. They reported a significant relationship between the concentration of contaminants at pre-incidence of heart attack (up to seven days before) and at the time of the heart attack. This relationship was significant for NO₂, CO, PM_{2.5} and PM₁₀ pollutants. In this study, ozone was the only pollutant that had no significant relation with acute heart disease [2]. Meng et al presented an article titled "Assessing and Promoting a High-Impact Noise Pollution Model with the L₂₀ as the Sound of the Cars." They believe that the Leq₂₀ model offers precise measurements of the sound level of the car, regardless of the car audio source as a point source. When the vehicle speed ranges is from 20 to 120 km / h, the deviation is between 80/0 and 0.13 dB [3]. Westergaard et al conducted a study entitled "Environmental pollution and the birth of low-birth-weight children and the assessment of the vulnerability of some women to air pollution compared to other women." They believe that environmental pollution can be controlled and it is also one of the biggest environmental threats to human health. Studies have shown that exposure to air pollution during pregnancy in mother's increases the risk of having a low birth weight baby. Pregnant women who smoke have low or high levels of body mass. And women with asthma are more likely to suffer from air pollution [4]. Shokouhian and Ghazinejad in an article entitled "Traffic and Its Role in Environmental Pollution," have investigated Traffic Pollution and its Impact and finally, they have come up with some solutions such as: speeding up the process of removing worn out vehicles, the use of a catalytic converter to convert carbon monoxide and unburnt hydrocarbons to carbon dioxide, development of public transport vehicles that are gas-fueled, telecommunication development, development of strengthening of Internet sites, establishing an e-government to reduce the use of vehicles and reduce audio contamination, isolating buildings, priority in the construction and use of subway, the use of sound walls along the highways, design and manufacture of soundproofing equipment in aircraft engines, cars and other transport vehicles [5]. Zarabi et al in an article entitled "Investigating the Effects of Greenhouse on Human Health," stated that dust is one of the air pollutants. The issue of air pollution, due to harmful effects on human health, has affected the lives of many societies [6]. Rahmati et al studied the pollution of the Sadr highway in an article entitled "Measuring and analyzing air pollutants in urban highways using GIS geographic information systems." According to the results, in winter, especially since the start of schools and the increase in traffic on this highway and climatic conditions in Tehran, the amount of pollutants measured significantly increased [7]. Delnavaz and Khalesi, in an article entitled "Evaluation of noise pollution in the large inner city bridges (case study of Sadr highway in Tehran), with the establishment of stations at various distances of the highway, has studied the amount of noise pollution before and after the construction of the Sadr bridge class. Prior to the construction of Sadr Bridge to the highway, for residential areas with a distance of 0.5 to 20 meters, 81.5 decibels were calculated. After bridging the bridge, this amount dropped to 74dB. With the Better the difference between L₁₀ and L₉₀, They concluded that the sensitivity of the inhabitants around, relative to Sadr highway has decreased and they less susceptible to noise pollution [8]. Sadeghian in a study entitled "Effect of green space on boulevards and highways in reducing noise pollution using a sound meter and completing related checklist" was concluded that silver cypress, common cypress, Tehran pine and elm are the best species in reducing sound pollution and they should be planted in green spaces of boulevards and highways [9]. Fashki and Belqiszadeh in an article entitled "Relationship of Air

Pollution with Deaths from Respiratory Disease in 6-12 Years Old Children between 2013 and 2015" concluded that During the period 2013 to 2015, 193 children lost their lives in Tehran due to respiratory problems [10]. There is also a significant relationship between the mortality associated with the disease with air pollution. Morrovati et al, in a research entitled "Application of remote sensing in the environment" identified and predicted the types of pollutants using the new, low-cost, and fast "remote sensing" method. Using this technology, he has analyzed various phenomena including dust, assessment of wetland change trends, meteorology and air quality. The study tries to measure air and noise pollution in the Sadr highway. After reviewing and analyzing, appropriate strategies for reducing these contaminations are presented, until the sensitive groups of society, including the elderly, patients and children, have not a bad condition [11]. Valipour et al. (2006), in an article entitled "The Environment and the Role of Traffic Management in Reducing Pollution and Air Pollution," tried to find solutions to reduce noise pollution and air pollution using traffic management solutions [12].

2. Material and Methods

Area of study

Sadr Highway was designed in 1973 (by Suferto Company) in Tehran. In 1993, a preliminary design was made and in 2013 the highway becomes two floors. Sadr's class bridge started east on the highway intersection of Sadr-Imam Ali highway. The bridge passes through the Novbnyad Square and the Sayyad Shirazi highway. At the intersection with Shahid Kaveh Boulevard and Qeytarieh Boulevard, ramps and loops provide the necessary supplies. While Sadr highway completing the highway traffic functions of the Niayesh Highway, it facilitates the flow of traffic on 7 highway Shahid Modares, Hemmat, Hakim, Resalat, Zayn al-Din, Yadgar Imam and Chamran.

Methodology

This research is a developmental-applied research and descriptive analytical method. The method of collecting information is field and library. For collecting information in a field, a questionnaire tool and a sound level meter were used and for collecting information in a library, Vector checker is used. The questionnaire of this research includes questions related to the effects of air and noise pollution on physical activity and mental and physical exhaustion that kind of questions are closed. The research questionnaire was a Fatigue Questionnaire with an evaluation of 5 and it provides a deeper and more accurate understanding of the person's fatigue. This questionnaire was first prepared by Smetes in 1996 and it's usable on the population of patients and healthy people. Includes 20 items and it is Based on the Likert Score of 5 points. In this research, face validity and content validity were used for validity of questionnaires and for reliability of the instrument; the Cronbach Alpha coefficient was used. The research community in this research is residents, students and staff of District 1 located near Sadr Highway. Morgan table was used to estimate the volume. Considering the location of Sadr highway in the first district of Tehran and the approximate population of 500,000 people in area 1, the number of questionnaires obtained from the Morgan table was 384. Data analysis was done by SPSS software. Geographic Information System (GIS) is also used to indicate the stations designated along the Sadr highway.

3. Results and discussion

Evaluation of noise pollution in Sadr Highway (Table 1)

According to the measurements, the audio level at the highway was 80 dB per day and 70 dB at night. The standard audio level in the residential area is 55 dB at day and 45 dB at night. The Pearson correlation coefficient between the mean pollution level, traffic volume and street width is shown in the table below.

Assessment of air pollution at Sadr Highway (Table 2)

The average of all concentrations of air pollutants in Tehran indicates that pollutants of suspended particles are the most important pollutants in Tehran. The air quality index was obtained at 106, 101 and 125 in the months of September, October and November which is unhealthy for sensitive groups. The Pearson correlation coefficient between the mean pollution level, traffic volume and street width is as follows:

Table 1: Pearson correlation coefficient between mean pollution level, traffic volume and street width

	Morning pollution level	traffic volume at day	Night pollution level	traffic volume at night	street width
Morning pollution level	1				
Night pollution level	0.503**	1			
morning traffic volume	0.279	0.325*	1		
night traffic volume	0.263	0.291	0.518**	1	
street width	-0.103	0.022	0.266	0.265	1

** Significant at 1% level

* Significant at 5% level

Table 2: Pearson correlation coefficient between mean pollution level, traffic volume and street width

	traffic volume at night	traffic volume at day	Night pollution level	Morning pollution level	street width
Morning pollution level	1				
Night pollution level	0.533**	1			
morning traffic volume	0.261	0.346*	1		
night traffic volume	0.269	0.284	0.524**	1	
street width	-0.119	0.034	0.257	0.274	1

** Significant at 1% level

* Significant at 5% level

Effect of noise pollution and air pollution on children's learning in the region (Table 3)

In order to investigate and present the model between noise pollution and air pollution (Y) and the reduction of children's learning (X), after reviewing the model's adequacy indicators presented in the following table, a processed model was presented.

Table 3: Fit the regression model between noise pollution and air pollution and reducing children's learning

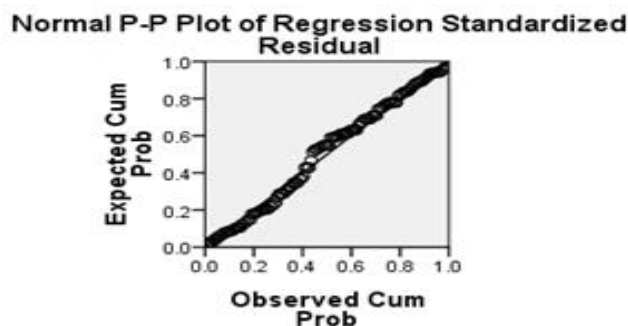
Error standard deviation	Adjusted coefficient of determination	The coefficient of determination	The correlation coefficient
0.447	0.456	0.461	0.679

The correlation between the independent variables and the dependent variable is equal to 0.679. 46.1% of the children's learning loss is related to hearing loss and airborne contamination. Because this value does not take into account the degree of freedom. Therefore, an adjusted adjustment coefficient is used for this purpose, which equals 45.6% in this test. According to the indexes mentioned, the model has the necessary qualifications (Table 4).

Table 4: Significance of regression by F test

Sig	F statistics	Average of squared sum	df	sum of squares	Model
0.000	103.31	20.64	1	20.64	regression
		0.20	121	24.18	left over
			122	44.82	Total

According to the above table, the significance level calculated for this statistic is equal to 0.000 and indicates the significance of the regression at 99%. The histogram plotted on the regression model confirms the assumption of the normality of the data. Therefore, the estimated linear regression model is acceptable.



Graph 1: Linear Regression Model Estimation Histogram

Table (5): Calculating the regression equation for reducing children's learning

Sig	T	Standard factor	Non-standard factor		Model	
		Beta	Std. Error	B	Constant	
0.000	-0.916	0.679	0.478	-0.438	Constant	1
	10.16		0.114	1.15	Audio and air pollution	

The dependent variable: Reduce children's learning

The variable entered in the regression equation is the core of the regression analysis, which is shown in the table above. The regression equation can be calculated using the standard non-standard coefficients as follows:

$$\text{Voice and Air Pollution (1.15) + (-0.438) = - Reduce children's learning}$$

It can be said that by upgrading a unit of each independent variable, the variable coefficient of the dependent variable will be enhanced. In other words, by upgrading one unit of noise and air pollution, 1.15 unit of standard deviation of children's learning reductions will be enhanced. As a result, they have a positive relationship. The t-test for regression coefficients is also shown in this table for the independent variable; this value is equal to 0.000 for this variable. It is therefore effective in reducing children's learning and the fifth hypothesis is also confirmed; that is, noise pollution and air pollution have a negative effect on children's learning in the region.

Conclusion

Air and noise pollution in Tehran is not good. Due to the potential effects on human health, a thorough and organizational review of these two issues is very important. Tehran as the capital of the country has become the center for the migration of people from other cities. Following this increase in population, there is an increase in traffic and then, the traffic has increased in Tehran. Sadr Highway with an average daily traffic of 100,000 vehicles is considered one of the most crowded highways in the city. According to the measure taken in this study, the level of sound balance on this highway during the day and night is more than allowed. The sound level was measured at 80 dB per day and 70 dB at night. Given that the Sadr highway is located in the residential area, the permissible sound level is 55 dB per day and 45 dB at night. The difference between the measured limits and the standard limits of contamination is well illustrated by the presence of noise pollution on the Sadr highway. Noise pollution has a negative effect on the body and nerves in the long time (Increases heart rate and blood pressure, motility, sleep disturbances, slower patient recovery, reduced learning in children, especially in conceptual lessons, reduced focus, especially in children in rehearsal courses, and so on), and residents around this highway are not immune to the effects of this pollution. On the other hand, the rate of air pollution on this highway is also more than allowed and the reason is the high level of traffic. According to the announced measurements, the index of air pollution on the highway during the three months of September was an unhealthy month for the sensitive groups. Residents around the highway, especially the elderly, patients, and children, have been negatively affected by this pollution. Cardiovascular diseases, respiratory diseases and pulmonary diseases are f the most common causes of this infection. Despite the air and noise pollution on this highway, the rate of children's learning as a part of sensitive groups also diminishes. The findings of this study

showed that there is a significant relationship between air and noise pollution and the reduction of learning in children in this region. As these infections increase, the amount of activity will be decreased unwittingly. Motivation decreases, especially in children, the motivation to respond to lessons is less than normal. Physical fatigue is common in people. Nervous tensions increase. Cardiovascular, pulmonary, respiratory, sleep disturbances and treatment costs increase. This suggests that managers and relevant authorities should pay more attention and they have to put forward the right planning and planning in this regard.

Suggestions for future research

- Studies on air and noise pollution in closed spaces such as tunnels are suggested, because awareness of the rate of air pollution index and the level of sound balance in closed spaces is preferable.
- It is recommended to compare the impact of air and noise pollution on athletes with non-athletes.

References

1. Dabiry, Minoo, Bashiri, Sohareh, Environmental pollution (air, water, soil, sound). Second Edition, *Publishing Alliance*, ISBN :964-5602-05-X (2016).
2. H. Mustafic, P .Jaber, C.Caussin, MH.Murad, S.Escolan, M.Tafflet, "Main air pollutants and myocardial infarction: a systematic review and meta analysis. *Jama*, 307 (7) (2002) 713-21.
3. Li.Meng, Traffic Energy and Emission Reductions at Signalized Intersections: A Study of the Benefits of Advanced Driver Information,*international journal of its research*, 7(1) (2015) 49-58.
4. NK. Vestergaard, U. Stephansen, L. Rasmussen, Airborne heavy metal pollution in the environment of a Danish steel plant. *Water, Air, and Soil Pollution*; 27 (2017) 363-77.
5. Shokouhian and Ghazinejad, Mohammad, Traffic and its role in environmental pollution, *5th National Congress of Civil Engineering, Mashhad, Ferdowsi University of Mashhad*, 2010, https://www.civilica.com/Paper-NCCE05-NCCE05_306.html
6. M. Zarabi, R. Mohammad, A. Sarah, Environmental effects of Greenpeace, *Second International Conference on Environmental Risks, Tehran, Kharazmi University*, 2015, https://www.civilica.com/Paper-ICEHH02-ICEHH02_071.html
7. R.Nasim, M. Ali, M.Sardad, Measurement and analysis of air pollutants in urban highways using GIS geographic information systems (case study: Sadr highway), *Fourth National Conference on Health, Environment and Sustainable Development, Bandar Abbas Islamic Azad University, Bandar Abbas Branch*, 2014. https://www.civilica.com/Paper-HESD04-HESD04_020.html.
8. D. Mohammad, K. Jalil, Evaluation of noise pollution in large inland bridges, case study: Shahid Sadr class highway Tehran, *Third National Conference on Air and Noise Pollution Management, Tehran, Sharif University of Technology*, 2014, https://www.civilica.com/Paper-CANPM03-CANPM03_079.html
9. S. Mohammad Mehdi, The Effect of Green Blvd and Urban Highways on Reducing Pollution in Isfahan, *National Conference on Sustainable Agriculture, Environment and Rural Development, Koohdasht, Kuhdasht Agricultural Jihad Department, Fifth Line*, 2016, https://www.civilica.com/Paper-SAERD01-SAERD01_004.html
10. F. Masoud, B. Hamid Reza, The association of air pollution with respiratory diseases death in children aged 6 to 12 years in Tehran during 2012 to 2014, *5th National Conference on Air and Noise Pollution Control, Tehran, Iran Clean Air Association*, 2017, https://www.civilica.com/Paper-CANPM05-CANPM05_011.html
11. M. Maryam, G.D.Pooneh, Application of remote sensing in the environment (identification and prediction of the occurrence of various pollutants), *Eighth National Conference and Specialized Exhibition of Environmental Engineering, Tehran, Iran Environmental Engineering Society*, 2017, https://www.civilica.com/Paper-CEE08-CEE08_251.html .
12. V. Setayesh, A.H B. Jafar, Nader, Environment and the role of traffic management in reducing air pollution & air pollution, *National Conference on Urban Environment, Tehran, Veterans Institute of Engineering Sciences and Medicine*, 2006, https://www.civilica.com/Paper-NCEUED01-NCEUED01_102.html

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