

## Effects of noise pollution on traffic policemen

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Received 7 Nov. 2008;

Revised 12 Jan. 2009;

Accepted 13 March 2009

**ABSTRACT:** Noise pollution can be considered as the most important problem of urban environmental management in mega metropolises and urban transportation is the main source of the mentioned problem. This study aims to investigate the amount of traffic noise dose received by traffic policemen in Tehran; District 1 Municipality. The investigation was conducted during three consecutive months in 2007 in 282 locations of the main streets of studied district which are known for its heavy traffic, as well as population flow. In order to measure the noise volume, pre-calibrated Cell – 450 and Quest – 2900 sound level meters were used. Regarding to noise dosimeter, 158 cases were measured using a dosimeter Cell-320. For this purpose,  $L_{eq}$ ,  $L_{10}$ ,  $L_{max}$  and  $L_{min}$  indicators were used. The results showed that the  $L_{eq}$  average during peak traffic load hours and in the least traffic conditions was  $77.2 \pm 2.1$  and  $64.5 \pm 2.2$  dB, respectively which were higher than the acceptable levels (55dB). Moreover, the statistical results showed the significant differences between light and heavy traffic conditions and also the direct effect of heavy traffic on noise pollution, also it was shown that vehicles traffic is the main source of the produced noise pollution. The study created a related questionnaire which evaluated the traffic policemen behavior from them and their relative's point of views. The results showed that noise pollution has damaging effects on their behavioral conditions and also, on their personal assessment. The policemen believed their psychological disorders and their relative had also the same opinion. This study attempted to show that noise pollution in metropolises such as Tehran is a serious problem and it is should be treated as a top priority in the urban environmental management in order to reduce noise pollution.

**Key words:** Heavy traffic, Metropolis, Noise dose, Urban environmental management

## INTRODUCTION

Nowadays, noise pollution is considered as one of the main problems of urban communities which has many hazardous effects on the urban environment and may result in a great deal of costs on the society (Martin *et al.*, 2006; Chien and Shih, 2007).) and traffic can be considered as the main source of noise pollution in large cities (Jamarah *et al.*, 2006 and Murthy *et al.*, 2007). According to the researches, noise pollution caused by traffic is one of the major problems in the southern large cities of Sweden (Skanberg and Ohrstrom, 2002 and Bjork *et al.*, 2006). In another research conducted in 2004 in the same country, in addition to mentioning the problems of noise pollution in

the big cities of Sweden, the researchers have demonstrated that noise effects will limit the episodic memory (Enmarker, 2004). The traffic policemen in metropolises are the most affected groups exposed to this dangerous factor during their working hours and in their leisure time. Ingle *et al.* (2006) have been measured the noise dose received by this group as 88 dB and, in some cases, it has been increased up to even 100 dB (Ingle *et al.*, 2006). Statistic results published by Organization for Economic Co-Operation and Development (OECD) in 1994 specified that more than 17 million people in France are exposed to sounds louder than 55 dB during 8-20 hours of their lives, whereas the minimum standard noise for noise pollution in the environment is 55 dB

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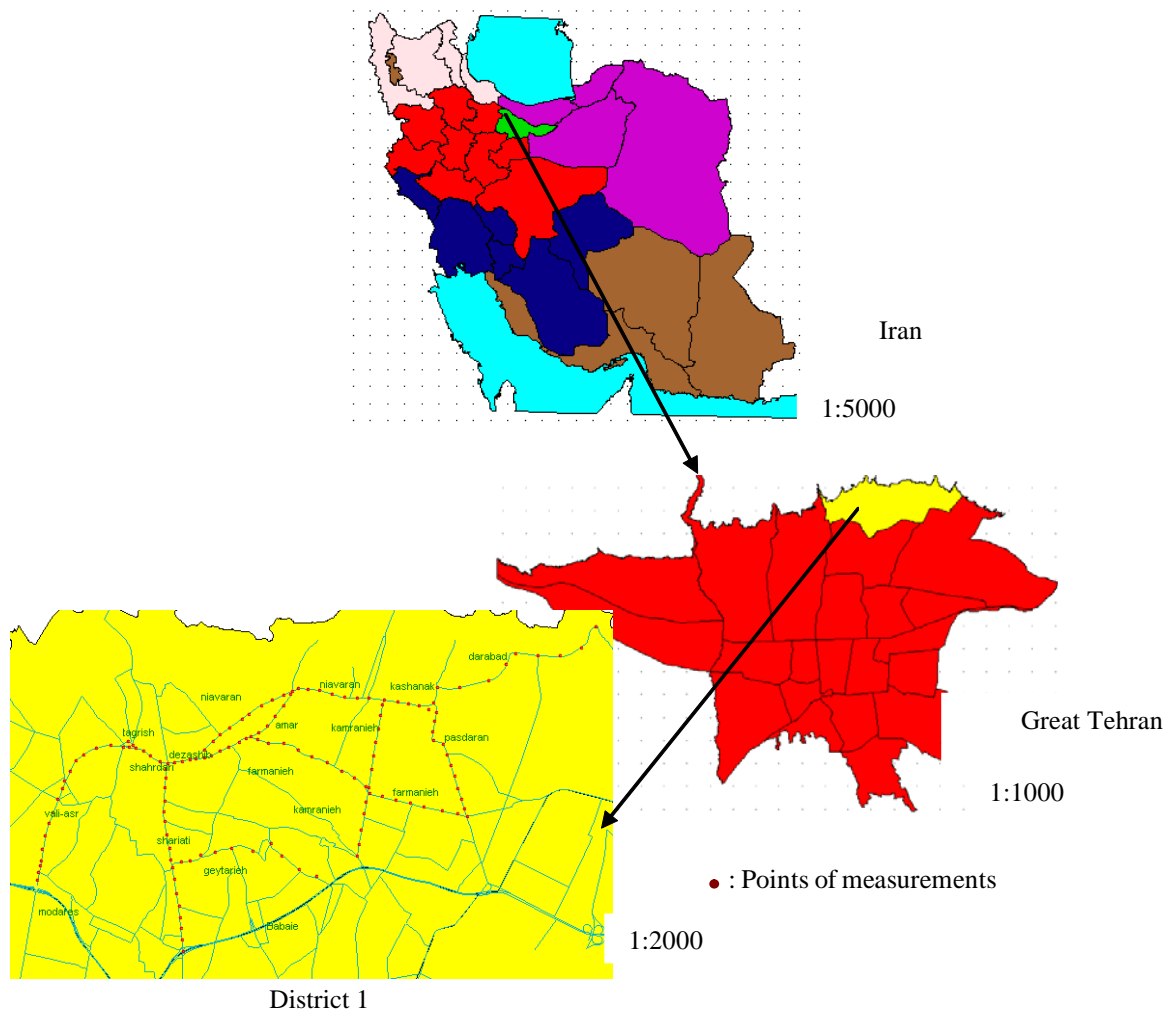
(Banerjee *et al.*, 2009). Canadian hearing society (CHS) researchers had considered urban environment as crowded, busy and noisy. Jackhammers pounding, sirens whining, alarms ringing, subway trains screeching, aircraft zooming overhead, car horns honking are a few of the annoying and potentially hazardous sounds face to dwellers. Moreover, it was concluded that the noise in some parts of these cities is so much that can lead to long-lasting and irrecoverable effects on the citizens and in places like masonry workshops and may increase above 100 dB. In this article, the traffic noise was measured as 89 dB, the car horns as 97 dB and the shopping centers as 81 dB. Regarding to the sound standards (less than 55 dB) determined by World Health Organization (WHO), studying of the urban environmental noise became significant (Banerjee *et al.*, 2009). Another research conducted in Spain showed that the noise pollution resulting from traffic is one of the main problems of the small and non-industrial cities (Barrigon *et al.*, 2002). Jacov *et al.* (2006) and Muzet *et al.* (2007) were also studied the effects of noise on the citizens sleep condition. In these researches, the minimum level of noise volume during day and night was measured as 65 and 55 dB, respectively. Meanwhile, it was designated that people who live in crowded areas suffer sleeping disorders (Jakovljevic *et al.*, 2006 and Muzet, 2007). Piccolo (2004) stated that the amount of sound in Messina is higher than normal. Thus, the urban environmental noise must be studied (Piccolo *et al.*, 2004). As stated in a report, a relatively high percentage of people considered the noise pollution as the biggest problem in London metropolis where the traffic noise has been selected as the main noise source by 23 % of people (Pathak *et al.*, 2008). Guite *et al.* (2006) studied the effects of urban environment over the public health and well-being and they concluded that the environmental noise can affect the mental health (Guite *et al.*, 2006). In a similar research conducted in Spain, it was demonstrated that the noise resulted from traffic can lead to physical and mental effects on the individuals (Vera *et al.*, 1992). Li *et al.* (2002) stated that the speed of the vehicles, the traffic load, the number of trucks and the road surface were also the main factors of traffic noise in Beijing (Li *et al.*, 2002).

## MATERIALS & METHODS

Regarding to the number of vehicles and the traffic load among the rich habitants of the district one of Tehran and by means of traffic organization and traffic police center data of the mentioned district, the traffic situation and the number of traffic policemen residing in the area were identified and their location were spotted. Then, the places that the measurement was supposed to carry out were located by means of available municipal maps taken from the traffic organization and also using four sound level meters (CELL-450 and Quest-2900) and the amount of which  $L_{eq}$ ,  $L_{10}$ ,  $L_{-max}$  and  $L_{-min}$  were measured. All the measurements were done in the peak of traffic during three months in the highest and the lowest traffic jam. Measurements were performed at a distance of zero from the signal stop line. The traffic jam and composition was taped using a video camera. The traffic jam during the measuring time was categorized into four groups and was recorded in information cards. In each measuring period, 141 cases were measured and altogether 282 locations in the main streets of the district were recorded, which are shown in Fig. 1. A significant difference between the level of noise dose received by traffic policemen in the minimum and the maximum traffic load was recorded ( $P < 0.05$ ).

In the next step, in order to measure the level of noise dose received by the traffic policemen, the measurement was done according to the short-term standard and the data collected from analysis of the traffic policemen job in a short-term period (1 h). The applied instrument for this research was CELL-320 for the noise pollution dosimeter. The measurements were accomplished using the dosimeters attached to the body of the policemen. After determining the work stations and directions and also, the time spent at each station, the system was installed on the direction for the considered time lag and the results were recorded. For this purpose, 79 cases were measured in each period of time and in two particular times; before and after the Iranian New Year, Norouz, in 2006.

Furthermore, a questionnaire, as shown in Table 1, was distributed amongst the elected policemen containing questions about their personal characteristic and moods. Also, some



**Fig. 1. Tehran city and the measured locations in the main streets**

questions were designed to be answered by their relatives, in order to evaluate the traffic policemen's moods. All the measurements were done on the side of one-way streets, just between the side-walk and the main street. In the two-way streets, this measurement was done on both sides of the street. In this research, the statistics such as mean and standard deviation for descriptive statistics methods were used. Regarding to the dependence of these samples on each other in different traffic conditions for demonstrating traffic effects on noise level, T-Test-paired method was used and statistical calculations were done by SPSS software.

## RESULTS & DISCUSSION

The residents of the studied district were asked about the most important environmental problems

which might have the highest effect in their lives. According to the final results, 45 % considered traffic as their most important problem. Furthermore, 43 % believed that the main traffic-related problem was sound pollution. The mean level of  $L_{eq}$  during the peak and the least hours of traffic in the streets were  $76.6 \pm 1.8$  dB and  $67.6 \pm 3.1$ , respectively as shown in Table 2. According to the changes in the streets and traffic conditions, the statistical results showed that there was a significant difference between the heavy and light traffic ( $P < 0.05$ ). In order to study the environmental noise and its level in the main streets of the mentioned district, which is shown in Table 2,  $L_{10}$  was calculated. The mean and standard deviations in  $L_{10}$  were calculated as  $75.5 \pm 1.7$  (before Norouz) and  $66.8 \pm 3$  (after Norouz) in the heavy and light traffic, respectively. The statistical

Table 1. The evaluation questionnaire of traffic policeman mental characteristics

Name:	Family name:	Years of service:	age:
1- What is your official employment status?		1- duty	2- official
2- Which one of the hazards is the most important in your duty?		air pollution noise pollution long term standing accident	
3- Which one of the noise pollution sources is most important for you?		1- traffic 3- Car horn	2- crowd 4- etc.....
4- Self-evaluate mood characteristics		1- very patient 2- patient	3- nervous 4- very nervous
This section is completed by your family			
In case of marriage:			
5- Which mood characteristic is for your husband / wife?		1- very patient 2- patient	3- nervous 4- very nervous
6- Which mood characteristic is for your father / mother?		1- very patient 2- patient	3- nervous 4- very nervous
In case of singleness:			
7- Which mood characteristic is for your children (traffic policeman)?		1- very patient 2- patient	3- nervous 4- very nervous
8- Which mood characteristic is for your brother / sister (traffic policeman)?		1- very patient 2- patient	3- nervous 4- very nervous

results showed that there was a significant difference between the minimum and maximum traffic load ( $P < 0.05$ ), while the level of  $LP_{max}$  measured in the minimum and maximum traffic flow shown in Table 2. As it can be seen in this table, the mean level of  $LP_{max}$  throughout the area was about  $97.1 \pm 4.3$  during the maximum traffic (before the Norouz) and about  $86.7 \pm 2.9$  during minimum traffic flow which showed the high noise level in the studied district. According to statistical results, there was a significant difference between the  $LP_{max}$  in various states of the traffic load ( $P > 0.05$ ). The other factor studied in this research was the level of  $LP_{min}$  which was measured at the maximum and minimum traffic load as shown in Table 2.

According to Table 2, the level of  $LP_{min}$  was  $63.7 \pm 3.7$  for the whole region before Norouz and then it was reduced to  $61.7 \pm 1.9$ . The final results did not show any significant difference between the highest and the lowest traffic load. However, this showed that traffic load affects the volume of noise pollution. The level of noise dose received by the policemen in these streets, as shown in Table 3, was also measured as about  $77.3 \pm 4.3$ . There were the final results of the effects of noise pollution on traffic policemen (official and duty traffic). The final results of the

biggest traffic-related problem that can be harmful for health are shown in Fig. 2.

The policemen (official and duty) were asked "What is the most important source of noise pollution in the cities?" The results are shown in Fig. 3. 56.5 % of the official policemen and 46 % of the duty policemen suffered from the effects of noise pollution. Furthermore, 67 % of the official policemen and 73 % of the duty policemen have suffered from insomnia problem. 52 % of the official and 61 % of the duty policemen had problem in work because of the noise pollution. 60 % of the official and 73 % of duty policemen complained about buzzing sounds in their ears after a noisy workday. This showed the primary effects of noise in their ears. It should be mentioned that only 15 % of the cyclist policemen had been worried about this problem. For a self-evaluation of the mood characteristics, the final results are shown in Fig. 4. The results of the question "How does your family evaluate your moral characteristics?" are shown in Fig. 5.

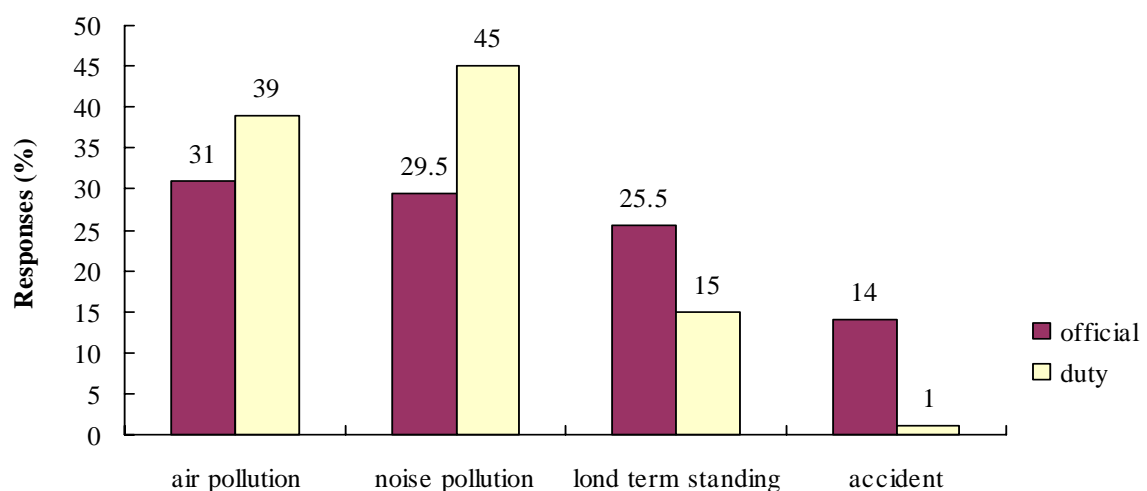
Like any other large cities in the world, the main streets of Tehran are also loaded with traffic flow, shopping centers and other activities which lead the residents suffer from noise pollution caused by the traffic. The final results in Tables 1 and 2 show that noise pollution is one of the main

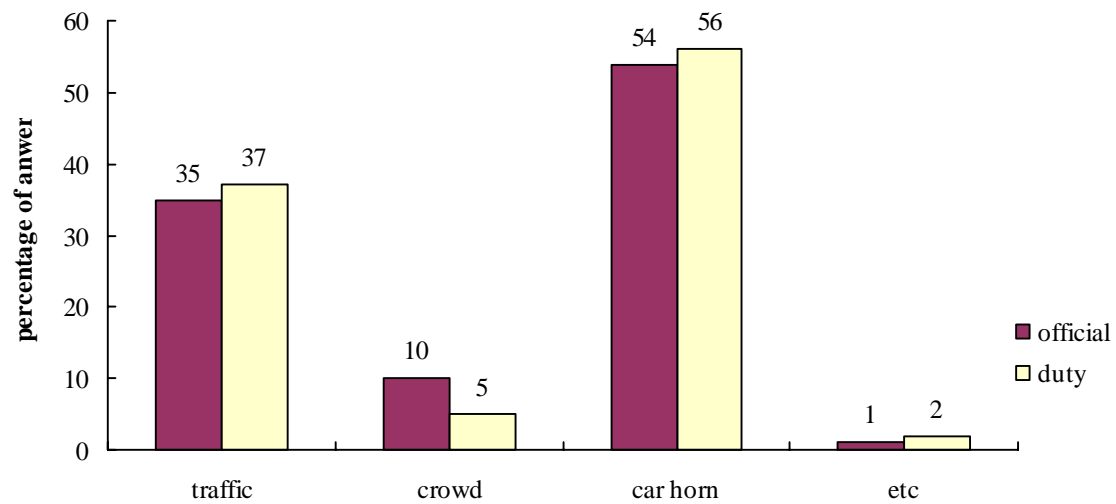
**Table 2. The mean values of  $L_{eq}$ ,  $L_{P_{10}}$ ,  $L_{P_{max}}$  and  $L_{P_{min}}$  in deferent traffic load in main streets of the District one, Municipality of Tehran**

Street	$L_{peq}$ (dB)		$L_{10}$ (dB)		$L_{P_{max}}$ (dB)		$L_{P_{min}}$ (dB)	
	Traffic load		Traffic load		Traffic load		Traffic load	
	Heavy	Light	Heavy	Light	Heavy	Light	Heavy	Light
Valiasr	78.4 ±1	68.8 ±1.2	77.4 ±1.1	67.7 ±0.9	99.5 ±1.9	87.7 ±4.5	61 ±1.6	51 ±1.1
Tajrish	78.9 ±1.2	68.6 ±1.1	77 ±1.4	67.2 ±1.1	99.5 ±1.9	88 ±6.4	60.1 ±0.7	50.2 ±0.3
Shahrdari	76.1 ±1.9	66.4 ±2.7	74.1 ±1.1	65.7 ±2.5	97.6 ±1.5	86.9 ±1.3	58.1 ±2.6	49.6 ±0.5
Gods	78.6 ±1.1	67.7 ±1.2	76.5 ±1.6	65.9 ±1.9	101 ±1.3	89.5 ±4.7	48.8 ±0.8	58.5 ±0.7
Shariati	77.4 ±1.3	67.6 ±1.3	75.8 ±1.2	67 ±0.96	98.9 ±0.8	86.8 ±2.6	51 ±2.3	60 ±0.96
Geytarieh	77.3 ±1.2	74.2 ±0.9	73.4 ±0.7	76.3 ±1	89.3 ±2.4	85.4 ±0.5	51.4 ±0.9	55 ±1.3
Pasdaran	75.4 ±1	67.5 ±0.9	74.9 ±0.8	66.8 ±0.8	98.2 ±1.2	88.2 ±1.1	59.5 ±1.2	52.1 ±0.7
Kamranieh	76.7 ±1.7	72.4 ±1.8	76 ±1.6	71.7 ±1.9	95.6 ±2.5	90 ±2.5	53.8 ±1.5	50.4 ±1.3
Niavaran	76.2 ±1.2	65.7 ±1.6	75.3 ±1.3	65.2 ±1.6	98.8 ±1.4	85.3 ±1.2	58.7 ±1.6	51.1 ±1.3
Dezashib	75.1 ±1	65.2 ±0.8	73.5 ±1.1	64.4 ±0.5	99.2 ±2.1	85.8 ±0.9	59.1 ±1.3	51.1 ±0.9
Amar	78.6 ±0.6	69.1 ±1.2	77.1 ±0.8	68.4 ±1.1	100 ±1.3	89.7 ±2.2	52.3 ±0.7	50.6 ±0.4
Farmanieh	75.4 ±2	64.1 ±1.4	74.8 ±2.1	63.4 ±1.5	95.2 ±2.8	85.7 ±1.3	57.7 ±2.1	49.9 ±1.2
Kashanak	75.8 ±1.7	65.3 ±1.1	75.1 ±1.6	64.4 ±1.2	92.7 ±4.1	84.4 ±0.7	58.3 ±0.9	52.2 ±0.1
Darabad	75.1 ±2.8	66.7 ±3.3	73.8 ±3.1	65.9 ±3.3	91.8 ±3.7	86 ±2.7	56.2 ±2	50.3 ±1.3

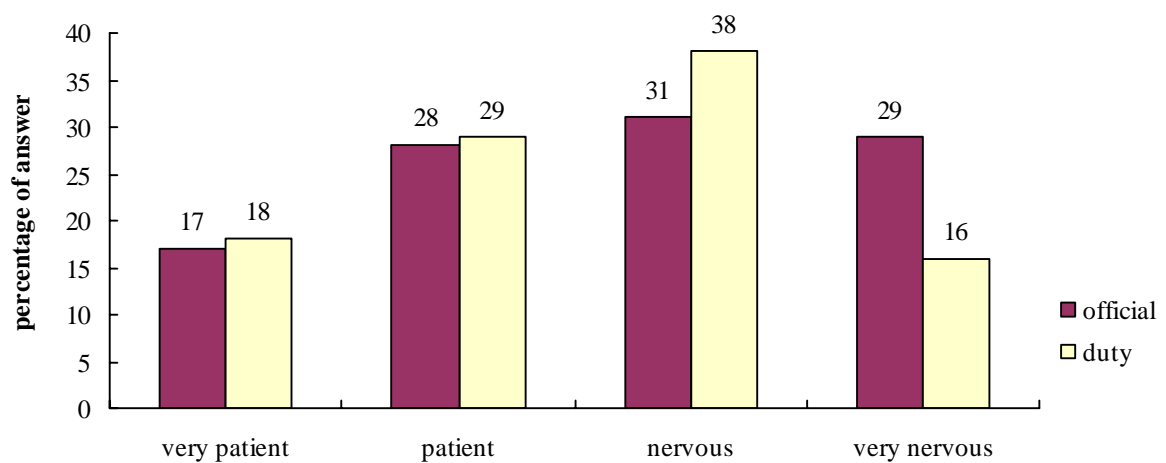
**Table 3. The level of noise dose in traffic policemen in different traffic load in The District one, Municipality of Tehran**

Street	$L_{Aeq}$ (dB)		Street	$L_{Aeq}$ (dB)	
	Heavy	Light		Heavy	Light
Valiasr	79.7 ±3.5	65.7 ±2.1	Pasdaran	77.9 ±1.3	65.6 ±1.2
Shahrdari	78.6 ±2.7	64.6 ±1.9	Daraband	78.5 ±1.3	64.4 ±0.9
Niavaran	76.2 ±3.8	62.3 ±2.1	Qeytarieh	74.5 ±2.3	62.3 ±1.8
Farmanieh	74.3 ±2.4	63.1 ±1	Dezashib	74.6 ±1.5	61.3 ±0.7
Kamranieh	77.3 ±1.5	64.2 ±1.3	Shariati	78.9 ±2.9	67.8 ±2.4
Aqdasiieh	75.3 ±1.1	63.3 ±1.5	Amar	77.1 ±1.3	61.9 ±1.3

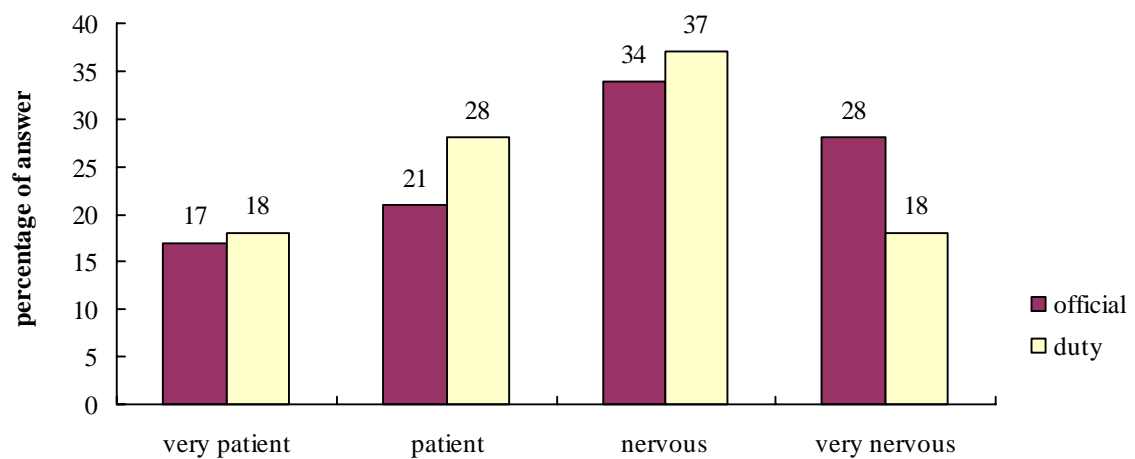
**Fig. 2. The most important hazards for traffic policemen in Tehran**



**Fig. 3. The percentage of answers to the question**  
"Which of noise pollution sources is the most important for you?"



**Fig. 4. The results of Self-evaluation of mental characteristics in traffic policemen**



**Fig. 5. The results of Family's evaluation of mental characteristics in traffic policemen's**

problems in Tehran, district one. The statistical results demonstrated a direct relationship between noise pollution and the traffic. Urban management should pay special attention to metropolises noise pollution and its control methods. The results showed that the street traffic level affects the noise pollution. According to the final results of  $Lp_{max}$ , it was demonstrated that this parameter had not a significant relationship with the traffic load and the number of vehicles because these factors were related to the car horns and the noise of the heavy truck engines (buses) which will be effective in case of changing the dominant culture and making technological changes to the buses engines (electrical or gas engine) which make less noise. The  $Lp_{min}$  is shown that the level of background noise in the cities was relatively high due to crowding of the people and this shows the critical condition of the large cities in relation to the noise pollution. This problem can be solved by a proportionate distribution of shopping centers in various neighborhoods which can be resulted in decrement in the number of trips within the city and the noise pollution. The street without shopping centers is free from these problems. One of the effects that finally can affect the nervous condition of the people was the interference of noise within the conversations. The research showed that many people complained about this issue during the high load traffic and the final results of this research have also confirmed this fact. The traffic policemen thought of noise pollution as the main environmental problem of their job and moreover, many of the residents of the mentioned area have considered the noise problem as the most important one of their district. The results achieved in the present research show that environmental noise can cause insomnia and this is more vivid in the less experienced duty policemen.

## CONCLUSION

The results can be considered as not being acquainted with the environmental noise. However, it was demonstrated that this phenomena had some effects on the personal characteristics and nervousness of the individuals as social consequences; therefore, importance of noise controlling management should be taken into considerations. It should be mentioned that the

effects of noise on the cyclist policemen was less than other groups because of their high-quality motorcycles and their use of helmet. As a solution to all the harmful problems caused by the traffic noise, it is necessary for these people to undergo periodical checkups to eliminate late diagnosis of hearing capability loss and problems in the mental and nerve systems. Finally, the municipal management must have special noise management planning in metropolises like Tehran; constructing shopping centers with appropriate and equal costs at each location so that traffics for shopping purposes would decrease; making e-commerce popularized; optimizing public transportation system with adequate capacity.

## ACKNOWLEDGEMENT

The authors would like to thank Miss Rafigi, Mr. Norouzi and Mr. Rezaee for the data collection, as well as IA Gazvin University for her financial support throughout the study.

## REFERENCES

- Banerjee, D. S., Chakraborty, K., Bhattacharyya, S. and Gangopadhyay, A. (2009). Appraisal and mapping the spatial-temporal distribution of urban road traffic noise. *Int. J. Environ. Sci. Tech.*, **6**(2), 325-335.
- Barrigon Morillas, J. M., Gomez Escobar, V., Mendez Sierra, J.A., Vilchez Gomez, R. and Trujillo Carmona, J. (2002). An environmental noise study in the city of caceres, Spain. *Appl. Acoust.*, **63** (10), 1061-1070.
- Bjork, J., Ardo, J., Stroh, E., Lovkvist, E., Ostergren, P. and Albin, M. (2006). Road traffic noise in southern Sweden & its relation to annoyance, disturbance of daily activities and health., *Scand. J. Work Environ. Health*, **32**(5), 392-401.
- Chien, M. K. and Shih, L. H. (2007). An empirical study of the implementation of green supply chain management practices in the electrical and electronic industry and their relation to organizational performances. *Int. J. Environ. Sci. Tech.* **4** (3), 383 – 394.
- Enmarker, I. (2004). The effects of meaningful irrelevant speech and road traffic noise on teachers attention , episodic and semantic memory. *Scand. J. Psychol.*, **45**(5), 393-405.
- Guite, H.F., Clark, C. and Ackrill, G. (2006). The impact of the physical and urban Environmental on mental well-being. *J. Public Health*, **120**(12), 1117-1126.

- Ingle, S.T., Pachpande, B.G., Wagh, N.D. and Attarde, S.B. (2006). Noise exposure and hearing loss among the traffic policemen working at busy streets of jogaon urban centre. *Transport. Res.*, **10**, 69-75.
- Jakovljevic, B., Lojevic, G., Paunovic, K. and Stojanov, V. (2006). Road traffic noise and sleep disturbances in an urban population: Cross-sectional study. *Croat. Med. J.*, **47(1)**, 125-33.
- Jamrah, A., Al-Omari, A. and Sharabi, R. (2006). Evaluation of traffic noise pollution in Amman, Jordan. *Environ. Monitor. Assess.*, **120**, 499-525.
- Li, B., Tao, S., Dawson, R.W., (2002). Evaluation and analysis of traffic noise from the main urban road in Beijing. *Appl. Acoustic.*, **63(10)**, 137-1142.
- Martin, M.A., Tarrero, M.A., Gonzalez, A. and Machimbarrena, M. (2006). Exposure-effect relationships between road traffic noise annoyance and noise cost valuations in Valladolid, Spain. *J. Appl. Acoust.*, **67 (10)**, 945-958.
- Murthy, K., Kamruzzaman Majumder, A., Nath Khanal, S. and Prasad Subedi, D. (2007). Assessment of traffic Noise Pollution in Banepa, A semi urban town of Nepal. Kathmandu University. *J. Sci. Eng. Tech.* **1**, 4.
- Muzet, A. (2007). Environmental noise, sleep and health. *Sleep Medicine Reviews*, **11**, 135-142.
- Pathak, V., Tripathi, B.D. and Kumar Mishra, V. (2008). Evaluation of traffic noise pollution and attitudes of exposed individuals in working place. *Atmosphere Environ.*, **42 (16)**, 3892-3898.
- Piccolo, A., Plutino, D. and Cannistraro, G. (2004). Evaluation and analysis of the environmental noise of Messina, Italy. *App. Acoustic.*, **66(4)**, 465- 470
- Skanberg, A. and Ohrstrom, J.F. (2002). Adverse health effects in relation to urban residential sound scopes. *J. Sound Vib.*, **250(1)**, 151-155.
- Vera, M., Vila, J. and Gadoe, J. F. (1992). Physiological and subjective effects of traffic noise: The role of negative self-statements negative. *Int. J. Psychophysiol.*, **12(3)**, 267-279.