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THE ASSOCIATION BETWEEN ROAD TRAFFIC NOISE EXPOSURE AND ANNOYANCE

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ABSTRACT:

Introduction: Exposure to road - traffic noise commonly engenders annoyance, the extent of which is determined by factors not fully understood. Our aim was to estimate the prevalence and determinants of road - traffic noise annoyance in taxi drivers in Qazvin.

Material and methods: This study was performed on 98 drivers of a selected route in Qazvin (all married). Equivalent noise levels [Leq (dB A)] were measured during day and evening in all streets of the route. According to ISO 9612: 2009, 8 h equivalent noise level [Leq8h (dB A)] were measured. Noise annoyance was estimated using self - reported annoyance scale.

Results: Noise annoyance showed strong correlation with noise levels and personal characteristics. The strongest correlation was found between the percentage of highly annoyed drivers and evening noise level (OR = 2.4). Logistic regression model identified increased risk for a high level of noise annoyance with regard to: age (OR = 0.95), smoking habit (OR = 1.9), educational status (OR = 0.026) and driving experience (OR = 2.1).

Conclusions: A considerable proportion of taxi drivers are highly annoyed by road - traffic noise, and perceive it to be a significant health risk. Knowledge of health risks of road - traffic noise, are associated with noise annoyance. There is necessity to establish an acceptable level of exposure noise for taxi drivers.

INTRODUCTION

Annoyance is the most prevalent health impact in workers exposed to environmental noise [1]. Although the auditory effects of noise on humans are accepted, non - auditory effects - the effects of noise exposure on human health, well -being and cognitive development- are less well accepted. Given the effect of chronic noise exposure on annoyance responses, it has been assumed that chronic noise exposure could have a serious impact on psychological health, as noise can cause annoyance and prolonged annoyance could lead to poor psychological health [2]. The impact of noise on psychological health is

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complex as studies have found that poorer psychological health is also related with greater annoyance responses [3, 4]. Major sources of environmental noise consist of road, rail, and traffic; construction and public works [5]. Annoyance is the most reported problem caused by traffic noise exposure and is often the primary outcome used to evaluate the effect of noise on communities. Acoustic factors such as noise source, exposure level and time of exposure in day only somewhat determine an individual's annoyance response: many non acoustical factors such as the extent of interference experienced, ability to cope, expectations, fear associated with the noise source, noise sensitivity, aggression and beliefs about whether noise could be reduced by those responsible influence annoyance responses. The growing request for road travel means that more people are being exposed to noise, and noise exposure is increasingly being seen as an important environmental public health issue. Studies have indicated a moderate effect of traffic noise on hypertension, cardiovascular disease and catecholamine secretion: there is also evidence for an effect on psychological symptoms but not for the onset of more serious clinically defined psychiatric disorder. One way noise may affect health is through annoyance: noise causes annoyance responses in persons and annoyance may cause subsequent illness. Several studies have shown positive exposure-response relationships between increasing environmental noise levels, at home, induced by road traffic, trains and airplane movements and annoyance [6 - 10], but there is a lack of studies assessing the relationship between transportation noise and annoyance in taxi drivers. Limit studies conducted about to noise annoyance in bus drivers [11 - 13]. This work aims to investigate the relationship between traffic noise and annoyance in Qazvin city.

MATERIALS AND METHODS

Selection of the route

The initial phase of the research, for selecting a noisy route, we used from study of noise pollution [14] and according to information of taxi department's management, one noisy route, with 9 streets, was selected for evaluation of noise. In the selected route, the traffic noise was measured again.

Study sample

All drivers of the selected route were considered as the sample of study. The criteria for the entry of drivers included: willingness to participate in the study, the lack of psychotherapy, drug addiction and alcohol consumption, at least 40 h driving per week as a job and at least one year of driving experience. The criteria for the exit of drivers from study included: ear infections or hearing loss unrelated to traffic and reluctance to continue cooperation. Finally, the sample considered for this study included 98 married male drivers.

Noise measurement

Once all the route and study sample, were selected, the next stage consisted on the application of the proposed measurement strategies for assessing noise exposure. As stated in ISO 9612: 2009, the selection of the most appropriate method (called "recommended" strategy in the standard) to measure noise exposure will depend on the job characteristics, namely the work type and pattern, including the mobility of the workers and the complexity of the task (s) carried out. Recommended strategies in ISO 9612: 2009 are three strategies, including the Task Based Measurement (TBM), the Job Based Measurement (JBM) and the Full Day Measurement (FDM). This standard proposed that only one should be selected for each type of workplace. As suggested by ISO 9612:2009, whenever the differences between the three primary measurements differed by more than 3 dB (A), full day measurement were taken. The dosimetry is the most reliable method to measure noise exposure. There is a short - term strategy for cases in which the noise exposure of the worker has a certain pattern. In this strategy, for each exposure time, the dosimeter is performed in a short period of time (at least 15 min) [15]. In the present study, a 4 h short - term dosimetry in the morning [8 - 10] and in the evening [16 – 18] shifts was performed. Measurements were carried out using the Casella cel sonus (GA257) dosimeter, set for fast response mode, using the A weighing curve. The microphone of the sound level meter was placed at 0.10 ± 0.01 m from the external ear of the taxi driver. The ear assessed for incoming noise was that receiving the higher value of the equivalent continuous A - weighted sound pressure level Leq, T dB (A). Noise exposure level was normalized to a nominal 8 h working day LEX, 8 h calculated from the measured equivalent sound pressure level Leq, T , Eq. (1) [16].

$$\mathrm{Leq8h} = 10\log[1/8 \sum_{n}^{i} t(10^{\frac{leqi}{10}})] \quad (1)$$

Leq 8 h: 8 h equivalent noise level (dBA)
Leqi: Daytime and evening equivalent noise levels (dBA)

Data collection

The questionnaire was anonymous and consisted of two parts. The first part included general socio-demographic data: age, educational status, number of children, smoking habit, employment experience, manufacturing years of vehicle, driving hours per day and second job. The second part included annoyance questions. Noise annoyance was estimated using verbal annoyance scale (0 – 4 graded “not at all”, “slightly”, “moderately”, “very” and “extremely”) according to recommendations of the International Commission on the Biological Effects of Noise (ICBEN) [17].

Statistical analysis

Descriptive statistic is presented as mean values ± standard deviation (SD), minimum and maxiimum values for numeric variables, or as percent (relative numbers) for categorical variables. The association between parametric data was measured by Pearson's correlation coefficient. Multiple logistic regression was performed to calculate odds ratios for the high level of noise annoyance in relation to the independent variables. Statistical software was used for all data analyses (SPSS Version 23) with significant level of $P < 0.05$.

RESULTS AND DISCUSSION

All drivers were informed of how the scale should be used and no subject had difficulty in filling it. The average age of the study population is 49.9, all married, 79.6 % had a low level of education, with 13.9 years of driving experience. Table 1 shows the characteristics of the study sample.
The results of noise measuring in the investigated route showed that average traffic noise levels were unfavorable for drivers. Average noise levels are represented in Table 2.
The extent of noise annoyance are represented in Table 3. The drivers who were “very” and “extremely” annoyed by noise were regrouped into a high level of noise annoyance.
Correlation between noise annoyance and noise exposure variables are represented in Table 4.
The strong correlation was found for noise levels (Leq and Leq 8 h) and noise annoyance.
Correlation analysis between noise annoyance and person - related variables is summarized in Table 5. Noise annoyance was significantly correlated with age, number of children, smoking habit, driving experience, manufacturing years of vehicle and the second job.

In order to assess predictive power of sound - related variables that showed strong correlation with noise annoyance a logistic regression was performed (Table 6). The strongest correlation was found for evening Leq T and high level of noise annoyance (odds ratio = 2.4).
Another logistic regression was conducted with person - related variables and noise annoyance. Noise annoyance was significantly and positively correlated with driving experiment (odd ratio = 1/2) (Table 7).
When asked to rate environmental factors by their hazardous effect, drivers found noise as the second most important. Air pollution was pointed out as the most important harmful factor.
This study gives clear evidence for impact of noise on driver's annoyance. Old vehicle, second job and smoking habit, was associated with increased risk of noise annoyance and concentration problems.

Table 1. Characteristics of drivers

Variable	Grouping	%	Mean ± SD (min - max)
Sex	man	100	
Marriage status	married	100	
Age	45 year ≤ 46 - 55 year 56 year ≥	28.6 36.7 34.7	10.9 ± 49.91
Educational status	sub diploma ≥ diploma	79.6 20.4	
Childs number	0 – 2 child 3 - 6 ≥ 7	36.7 35.7 27.6	2.8 ± 3.9 (0 - 9)
Smoking habit	Yes No	60.2 39.8	
Driving experience in taxi driver job	1 - 10 11 - 20 ≥ 21	35.7 39.8 24.5	6.9 ± 9.13 (2 - 27)
Manufacturing years of vehicle	1377 ≥ 1378 - 91 ≥ 1392	38.8 33.7 27.6	1383 ± 8/2 (1370 - 96)
Second job	Yes (high noise) Yes (low noise) No	39.8 33.7 26.55	

Table 2. Noise dosimetry information

Acoustical characteristics	Mean ± SD	Min	Max
Daytime Leq T (dBA)	1.2 ± 80.9	78.1	83.3
Evening Leq T (dBA)	1.2 ± 82.7	79.8	84.9
Leq8h	1.3 ± 81.8	79	84

Table 3. Percentage of noise annoyance's components

Variable	Grouping	Percent
Annoyance	not at all	12.2
	slightly	14.3
	moderately	21.4
	very	21.4
	extremely	30.6

Table 4. Pearson's correlation coefficient for noise levels and noise annoyance.

	Acoustical characteristics	P_{value}	Correlation coefficient
Annoyance	Daytime LeqT (dBA)	0.002	0.517
	Evening LeqT (dBA)	0.001	0.582
	Leq8h	0.001	0.572

Table 5. Correlation analysis between noise annoyance and person - related variables

	Variables	P_{value}	Correlation coefficient
Noise annoyance	Age	0.001	0.344
	Children number	0.000	0.422
	Marriage status	0.153	0.095
	Educational status	0.053	0.095
	Smoking habit	0.000	0.391
	Driving experience in taxi driver job	0.001	0.344
	Manufacturing years of vehicle	0.000	0.376
	Second job	0.000	0.356

Table 6. Odds ratio (95 % confidence interval) noise related variables for high levels of noise annoyance

Acoustical characteristics	OR*	Standard error	df	P_{Value}
Daytime LeqT (dBA)	0.98	0.901	1	0.046
Evening LeqT (dBA)	2.4	1.49	1	0.036

*: OR = Odds Ratio

Table 7. Odds ratio (95 % confidence interval) of socio - demographic variables for high levels of Noise annoyance

Variable	OR	Standard error	P_{Value}
Age	0.95	8.6	0.006
Smoking habit	1.9	1.6	0.04
Educational status	0.026	1.53	0.017
Driving experience in taxi driver job	2.1	1.6	0.02

CONCLUSIONS

The results of this study reveal that the drivers of our study were more annoyed from evening equivalent noise levels. This finding may be explained by the fact that the number of vehicles is relatively high in selected route during evening. One study shows that number of vehicles during nighttime and daytime correlate with noise annoyance [18]. This is similar to the findings of study in 1991 [19], who reported increase of the extent of annoyance with the increase of noise events, suggesting that the number of heavy vehicles can be a good indicator of the number of noise events for road traffic noise. The relationship between noise annoyance and number of noisy events was also confirmed for aircraft noise [20]. On the other hand, study in 1999 [21] found strong correlation between noise annoyance caused by traffic noise and noise levels, but not with the number of noise events.

Levels of 85 dB (A) is the current WHO guideline for acceptable noise levels at the most exposed workplace. Values recorded were at a threshold below 85 dB (A). However, in the present study 30.6 % reported being highly annoyed due to road traffic noise. On the other hand, NR - 17 standard [22] (regulation act 17: ergonomics) establishes that a level of exposure exceeding 65 dB (A) during 8 h of work is considered uncomfortable. Therefore, current values recorded should not be considered optimal for health and should be reduced in order to improve the workstation of taxi drivers subjected to such noise levels.

The measured noise on the taxies indicates that the vehicles are in accordance with Brazilian standard occupational in bus drivers workplace; however, appears above the comfort limits for work.

Organizational changes in the workplace and use of noise control measures can contribute to a better working environment for taxi drivers.

Since there is a lack of guideline for acceptable noise levels at the most exposed taxi driver's work station, it seems necessary to establish an acceptable level of exposure noise for these professionals.

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COMPETING INTERESTS

The authors declare no conflict of interest.

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ETHICAL CONSIDERATIONS

Authors are aware of, and have complied with, best practices in ethics, specifically with regard to authorship, dual submission, manipulation of figures, competing interests and compliance with policies on research ethics. Authors adhere to publication requirements that the submitted work is original and has not been published elsewhere in any language.

REFERENCES

[1] Ragettli MS, Goudreau S, Plante C, Perron S, Fournier M, Smargiassi A. Annoyance from road traffic, trains, airplanes and from total environmental noise levels. International journal of environmental research and public health. 2015;13(1):90.
[2] McLean E, Tarnopolsky A. Noise, discomfort and mental health: a review of the socio-medical implications of disturbance by noise. Psychological Medicine. 1977;7(1):19-62.
[3] Tarnopolsky A, Barker S, Wiggins R, McLean E. The effect of aircraft noise on the mental health of a community sample: a pilot study. Psychological Medicine. 1978;8(2):219-33.
[4] Van Kamp I, Houthuijs D, van Wiechen C, Breugelmans O, editors. Environmental noise and mental health: evidence from the Schiphol monitoring program. INTER-NOISE and NOISE-CON Congress and Conference Proceedings; 2007: Institute of Noise Control Engineering.
[5] Schomer PD. Criteria for assessment of noise annoyance. Noise control engineering journal. 2005;53(4):125-37.
[6] Héritier H, Vienneau D, Frei P, Eze IC, Brink M, Probst-Hensch N, et al. The association between road traffic noise exposure, annoyance and health-related quality of life (HRQOL). International journal of environmental research and public health. 2014;11(12):12652-67.
[7] Miedema H, Oudshoorn C. Annoyance from transportation noise: relationships with exposure metrics DNL and DENL and their confidence intervals. Environmental health perspectives. 2001;109(4):409.
[8] Commission E. Position paper on dose response relationships between transportation noise and annoyance. 2002.
[9] Öhrström E, Barregård L, Andersson E, Skånberg A, Svensson H, Ängerheim P. Annoyance due to single and combined sound exposure from railway and road traffic. The Journal of the Acoustical Society of America. 2007;122(5):2642-52.
[10] Organization WH. General guidelines for methodologies on research and evaluation of traditional medicine. 2000.
[11] Zannin PHT. Occupational noise in urban buses. International Journal of industrial ergonomics. 2006;36(10):901-5.
[12] Mondal NK, Dey M, Datta JK. Vulnerability of bus and truck drivers affected from vehicle engine noise. International Journal of Sustainable Built Environment. 2014;3(2):199-206.
[13] Bruno PS, Marcos QR, Amanda C, Paulo ZH. Annoyance evaluation and the effect of noise on the health of bus drivers. Noise and health. 2013;15(66):301.
[14] Emamjomeh M, Nikpay A, SAFARI VA. Study of Noise Pollution in Qazvin (2010). 2011.
[15] Dehghan SF, Nassiri P, Monazzam MR, Aghaei HA, Moradirad R, Kafash ZH, et al. Study on the noise assessment and control at a petrochemical company. Noise & Vibration Worldwide. 2013;44(1):10-8.
[16] Standardization IOf. Acoustics: Determination of Occupational Noise Exposure and Estimation of Noise-Induced Hearing Impairment: International Organization for Standardization; 1990.
[17] Fields J, editor Recommendation for shared annoyance questions in noise annoyance surveys. Proc 7th International Congress on Noise as a Public Health Problem; 1998.
[18] Jakovljevic B, Paunovic K, Belojevic G. Road-traffic noise and factors influencing noise annoyance in an urban population. Environment international. 2009;35(3):552-6.
[19] Björkman M. Community noise annoyance: importance of noise levels and the number of noise events. Journal of Sound and Vibration. 1991;151(3):497-503.
[20] Quehl J, Basner M. Annoyance from nocturnal aircraft noise exposure: laboratory and field-specific dose–response curves. Journal of Environmental Psychology. 2006;26(2):127-40.

[21] Sato T, Yano T, Björkman M, Rylander R. Road traffic noise annoyance in relation to average noise level, number of events and maximum noise level. Journal of Sound and Vibration. 1999;223(5):775-84.
[22] Kloimüller I, Karazman R, Geissler H, Karazman-Morawetz I, Haupt H. The relation of age, work ability index and stress-inducing factors among bus drivers. International Journal of Industrial Ergonomics. 2000;25(5):497-502.