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The Impact of Road Traffic Noise on Hospital Workers

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Abstract

Background/Objectives: None of the researchers has investigated the risk on workers exposed to noise pollution inJordan. This study tries to fill in this gap through investigating the effect of traffic noise on the performance of hospital workers in Amman, the capital of Jordan, as a specific affected group. **Method:** Noise levels were measured at locations adjacent to three main hospitals with readings taken during two 1-hour periods 12 hours apart. A cross-sectional attitudinal survey was carried out in these hospitals using a predesigned questionnaire. A pilot study was carried out in order to examine if there was any feedbacks before the full-scale survey is launched. A sample of 150 participants from medical care personnel in the three hospitals including doctors, nursing staff and administrators, were subjected to self – answered questionnaire and 145 questionnaires were valid returns indicating a high response rate. **Findings:** The results reveal that the studied hospitals suffer much higher noise levels than the permissible limits and these levels were found to have a negative impact on workers' and patients outcomes. More than 43% of the medical care staff reported that they always get annoyed by traffic noise and this causes them a difficulty in concentration and distract their attention while working. 50% agree that traffic noise has a negative impact on their performance. 26% of the survey participants reported that they suffer from headache due to the high noise levels and as such some potential countermeasures to mitigate the problem are recommended. **Conclusion/Improvements:** The average measured sound levels were found to be much higher than the environmental daytime[1]and nighttime noise limits required by the regulations in Jordan. Noise pollution was also found to either directly or indirectly affects, in a simultaneous manner, the subjective perception of noise, emotion, physiology and experience of noise of the medical care staff.

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Keywords: Attitudinal Survey, Hospitals, Jordan, Traffic Noise, Working Places

1. Introduction

Noise can be emitted from different sources such as: factories, aircrafts, railways and road traffic with the last being the chief "offender"[1].

Road Traffic Noise (RTN) is a combination of the noises produced by vehicle engines, exhaust, and tires. It increases by defective mufflers or other faulty equipment. Also it is not constant; noise levels change with the number, type, and speed of the vehicles.

Many recent studies have investigated the health effects of noise pollutant on exposed residents[2–5], and the noise impact on workers at specific working places[6–8]. More specifically, a number of studies have investigated the impact of unwanted sound on patient outcomes and caregiver effectiveness. Cmiei et al.[9] reported noise as a main source of sleep disturbance amongpatients which also decreases their confidence in the professional competence of the clinical staff. Blomkvist et al.[10] found that patients in a coronary critical care unit judged healthcare worker attitudes and care to be much better during the lower acoustical periods. They also found that the workers exposed to different noise levels over the workday reported higher levels of stress.

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During the last two decades, the city of Amman, the capital of Jordan, has been subjected to significant demographic and spatial changes coupled with dramatic growth of vehicular traffic. This has led to an increase in the magnitude of RTN levels and growing concern among residents of the health impact of these levels. Yet, only few studies were carried out to investigate, evaluate and control noise pollution in Amman[4,11–15]. However, none of these studies has investigated the risk on workers exposed to noise pollution in the various working places. Therefore, this study further investigates the noise pollution in Amman and focuses on the impact of noise pollution on medical care workers and patients in hospitals.

2. Methodology

Recent measurements of Road Traffic Noise (RTN) levels at several locations in Amman city, the capital of Jordan were used for the purpose of this study where L10 (1h) and L_{eq} noise levels were determined with readings taken during two 1-hour periods between 7:00 and 8:00 and between 19:00 and 20:00 The two periods which are 12 hours apart aimed to cover the morning and evening traffic conditions during work days in summer.

A structured questionnaire was prepared to evaluate the annoyance level of the medical care staff caused by traffic noise pollution around hospitals.

The first part of the questionnaire includes the independent variables affecting the level of annoyance of the medical care staff such as:

- Sex.
- Age.
- Profession (doctors, nurses or administrators).
- Marital status.
- Educational background.
- Hospital department.
- Work shift.
- Work experience.

The second part includes questions that show subjective perception of ambient noise and its effects on health.

3. Data Collection

A pilot study was carried out at the beginning by distributing 10 questionnaires in order to examine if there was any feedbacks on the questionnaire before the full-scale survey is launched. The questionnaire was then put in it's final form and fully distributed.

A sample of 150 participants from medical care personnel in the three hospitals including doctors, nursing staff and administrators, were subjected to self – answered questionnaire to investigate the health and social impacts of road traffic noise on them. 145 questionnaires were valid returns indicating a high response rate of about 97%.

4. Results

The noise survey results revealed the measured noise levels at locations adjacent to hospitals were found to be range between70 and 75 dB (A) which exceeds those suggested by local regulation of 45 dB for educational institutes and hospitals as shown in Table 1. Based on these results the three hospitals were selected to study the impact of traffic noise on the medical care staff. These hospitals together with the number of respondents from each hospital are listed in Table 2 which also shows the day and night measured noise levels at the studied locations.

Table 1. Maximum equivalent sound levels for different areas in Jordan

Area	Leq dB (A)	
	DAY	NIGHT
Residential areas in cities	60	50
Urban areas	55	45
Residential areas in villages	50	40
Residential areas including workshops, handicraft centers, commercial areas and city center.	65	55
Industrial areas (heavy industries)	75	65
Educational institutes, hospital and worship places	45	35
Source : Ministry of Environment [17].		

Analysis of the collected data revealed the results shown in Tables 3 and 4. The figures in the tables represent detailed average values of the overall sample; the actual values for each hospital will be discussed in the following sections.

4.1 Sample Characteristics

Table 3 shows the detailed characteristics of the sample

- The overall sample consists of 57% female with 43% males, 48% are between 25 and 35 years old while 9.0% are more than 50 years old.

Table 2. Day and night noise levels at the selected sites

Location Identification	Noise Levels dB (A)		Hospital		No. oF Respondents
	Day Time	Night Time			
Fifth circle	70	68	Arab Medical Centre	(AMC)	50
Al-Madina Al-Munawara	70	67	Ibn Al-Haitham Hospital	(IHH)	50
Queen Rania st.	72	72	Jordan University Hospital	(JUH)	45
Source: Obaid et al, 2012[11].					

Table 3. Sample characteristics (%) for each hospital

	Traffic noise annoys me			
	Always	Sometimes	Rarely	Never
AMC	42.0	30.0	18.0	10.0
IHH	44.0	42.0	6.0	8.0
JUH	42.0	44.0	14.0	0.0
Average	42.67	38.67	12.67	6.0
	Traffic noise is an environmental pollutant				
	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
AMC	56.0	36.0	8.0	0.0	0.0
IHH	44.0	40.0	10.0	6.0	0.0
JUH	52.0	42.0	4.0	0.0	2.0
Average	50.67	39.33	7.33	2.0	0.67
	Traffic noise has an impact on my performance				
	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
AMC	36.0	42.0	8.0	10.0	4.0
IHH	10.0	62.0	16.0	10.0	2.0
JUH	18.0	46.0	26.0	10.0	0.0
Average	21.33	50.0	16.67	10.0	2.0
	How would you classify the traffic noise around your hospital				
	Very high	High	Moderate	Low	Very low
AMC	16.0	10.0	28.0	18.0	28.0
IHH	10.0	30.0	50.0	6.0	4.0
JUH	18.0	36.0	36.0	8.0	2.0
Average	14.67	25.33	38.0	10.67	11.33
	How long you have been working in this hospital				
	Less than 5 years	5-10 years	More than 10 years		
AMC	66.0	24.0	10.0		
IHH	66.0	22.0	12.0		
JUH	72.0	16.0	12.0		
Average	68.0	20.67	11.33		
	How does the traffic noise level changed in this period				
	Highly increased	Slowly increased	No change	Decreased	
AMC	26.0	28.0	38.0	8.0	
IHH	22.0	34.0	36.0	8.0	

JUH	28.0	42.0	30.0	0.0
Average	25.33	34.67	34.67	5.33

	What does traffic noise cause to you				
	Mood Disturbance	**Difficulty in concentration**	**Headache**	**Distract my attention while working**	**Nothing**
AMC	23.5	21.5	13.5	17.5	24.0
IHH	18.0	16.0	41.0	7.0	18.0
JUH	32.5	20.5	22.5	14.5	10.0
Average	24.67	19.33	25.67	13.0	17.33

	What time of day does RTN bother you the most					
	Morning	**Afternoon**	**Evening**	**At night**	**All the time**	**Never**
AMC	22.0	33.0	7.0	14.0	16.0	8.0
IHH	30.0	21.0	13.0	6.0	16.0	14.0
JUH	44.0	26.0	11.0	9.0	8.0	2.0
Average	32.0	26.67	10.33	9.67	13.33	8.0

	Which of the following are most affected by Traffic Noise (TN)				
	The elderly (male)	**The elderly (female)**	**Middle aged (male)**	**Middle aged (female)**	**children**
AMC	28.6	37.3	8.0	14.6	11.5
IHH	29.5	22.5	15.2	12.8	20.0
JUH	34.8	20.8	18.4	13.8	12.2
Average	31.0	26.9	13.9	13.7	14.5

- 35% of the sample are doctors (18% of the JUH sample are dentists), 38% are nursing staff while the rest are administrators and other professions like nursing practical, with different work shifts (A, B and C shift)*.
- The work experience of about 41% is less than 2 years, 31% between 2 and 6 years, 9% between 6 and 10 years and those with work experience more than 10 years constitute about 18% of the overall sample.
- The majority of the sample (66%) is graduated from Jordanian universities while 15% from western universities and the rest are graduated from other Arab countries.

*A shift: 8 A.M. till 4 P.M. B shift: 4 P.M. till 12 P.M. C shift: 12 P.M. till 8 A.M.

4.2 Response to Noise

Table 4 shows the detailed analysis of the response of interviewed persons to traffic noise, revealed the following results:

- 42.7% of the medical care staff always get annoyed because of traffic noise; while 38.7% sometimes get annoyed by traffic noise and 6% are never get annoyed.
- More than the halves of the sample strongly agree that traffic noise is an environmental pollutant andonly 2% disagree with this perception.
- Studying the existence of an impact of current noise levels on the performance of staff revealed that about 21% of respondents strongly agree, and 50% agree that traffic noise has an impact on performance while only 10% disagree this perception.
- The respondents were asked to classify the traffic noise around their hospitals: Nearly 15% considered the noise is very high and 25% said that it is high, while 11% claimed that traffic noise is low, and 11% said that it is very low. These results leads to conclude that a total of about 40% of respondents perceive the neighboring noise level as high or very high.
- 68% of the respondents have been working for a period less than 5 years in a certain hospital and 11% have been working for more than 10 years, about 25% see that the noise level highly increased, 35% slowly increased, 35% noticed no change and 5% feel that the noise level has decreased during the period of working in their hospitals.

Table 4. Response to traffic noise (%) for each hospital

	SEX			
	Male		**Female**	
AMC	30		70	
IHH	48		52	
JUH	50		50	
Average	42.67		57.33	
	AGE (years)			
	Less than 25	**25-35**	**35-50**	**More than 50**
AMC	14	70	8	8
IHH	30	40	22	8
JUH	40	34	16	10
Average	28	48	15.33	8.67
	MARITAL STATUS			
	Single	**Married**	**other**	
AMC	76	24	0.0	
IHH	44	54	2.0	
JUH	76	24	0.0	
Average	65.33	34.0	0.67	
	TYPE OF WORK			
	Doctors	**Administrators**	**Nursing Staff**	**Others**
AMC	12	6	70	12
IHH	32	16	28	24
JUH	60	6	16	18
Average	34.67	9.33	38.0	18
	WORK EXPERIENCE (YEARS)			
	Less than 2	**2-6**	**6-10**	**More than 10**
AMC	40	40	6	14
IHH	34	28	12	26
JUH	50	26	10	14
Average	41.33	31.33	9.33	18
	GRADUATION UNIVERSITY			
	Jordanian universities	**Other Arab universities**	**Western universities**	
AMC	70	12	18	
IHH	56	26	18	
JUH	72	18	10	
Average	66.0	18.67	15.33	

- Investigating the health impact of traffic noise resulted in 24% of the respondents reporting that traffic noise can cause a mood disturbance and 19% traffic noise cause a difficulty in concentration with nearly 26% suffer a headache from high noise levels, 13% show that traffic noise distract their attention while working, and finally 17% are not affected by the current traffic noise levels.
- Morning and afternoon are the most time of day that bothers the Medicare givers: 32% reported that

Table 5. Characteristics of respondents who are "always" annoyed by TN (%) for each hospital

	SEX					
	Male		female			
AMC	28.6		71.4			
IHH	63.6		36.4			
JUH	38.1		61.9			
Average	43.7		56.3			
	AGE (years)					
	Less than 25	25-35		35-50	More than 50	
AMC	19.0	61.9		4.8	14.3	
IHH	22.7	36.4		27.3	13.6	
JUH	33.3	42.9		19.1	4.8	
Average	25.0	46.9		17.2	10.9	
	MARITAL STATUS					
	Single	Married		Other		
AMC	71.4	28.6		0.0		
IHH	27.3	72.7		0.0		
JUH	66.6	33.3		0.0		
Average	54.7	45.3		0.0		
	TYPE OF WORK					
	Doctors	Administrators	Nursing Staff		Others	
AMC	14.3	4.8	76.2		4.8	
IHH	31.8	13.6	27.3		27.3	
JUH	66.6	0.0	23.8		9.5	
Average	37.5	6.3	42.2		14.0	
	WORK EXPERIENCE (YEARS)					
	Less than 2	2-6	6-10		More than 10	
AMC	28.6	52.4	0.0		19.0	
IHH	27.3	13.6	18.2		40.9	
JUH	47.6	47.6	9.5		28.6	
Average	34.4	26.6	9.4		29.6	
	GRADUATION UNIVERSITIES					
	Jordanian universities	Other Arab universities		Western universities		
AMC	61.9	4.8		33.3		
IHH	50.0	22.7		27.3		
JUH	57.1	28.6		14.3		
Average	56.2	18.8		25.0		
	WHAT TIME OF DAY DOES RTN BOTHER YOU THE MOST					
	Morning	Afternoon	Evening	At night	All the time	Never
AMC	23.8	40.5	2.4	0.0	33.3	4.8
IHH	22.7	18.2	18.2	4.5	27.3	4.5
JUH	47.6	28.6	9.5	4.8	9.5	0
Average	31.3	28.9	10.2	3.1	23.4	3.1

morning is the time of the day they get bothered by road traffic noise the most while 26.7% said that this time is an afternoon time, with 10% see that the evening time is the most bothering one, 13% consider that all the time the traffic noise bothers them and 8% never get bothered by traffic noise.

- When asked about the patients' category most affected by traffic noise from the medical point of view, 31% of respondents reported that the elderly men is the most affected while approximately 27% show that the elderly women are the most, 14% considered the middle aged men are the most affected and around 14% for the middle aged women and 14% considered that the children are the most affected by traffic noise. Thus the elderly patients constitute are perceived as the most affected age group.

A detailed analysis was carried out for the group of respondents who reported that they are "always" annoyed by traffic noise. This group constitutes significant properties of about 43% of the total interviewed persons. The results of the analysis exhibited in Table 5 give the characteristics of this group and reveal the following facts:

- About 56% of this affected group is females, 45% are married, 38% are doctors and 42% are nursing staff.
- About 35% have less than 2 years of work experience and about 30% have more than 10 years. More than 56% are graduates of Jordanian universities and about 25% are western graduates.
- More than 23% are annoyed all the time. The highest proportion of this group (more than 31%) are annoyed most during morning working hours followed by about 29% annoyed most in the afternoon.

Assuming the same distribution of the total and this group characteristics, it can be deduced that the main factors affect the degree of annoyance include the marital status where singles constitute about 55% of the total sample and 65% of those always annoyed. The other main factor is the working experience where those of more than 10 years of experience constitute about 18% of the total sample compared with 30% of those always annoyed, meaning it is the most affected group.

Comparing these results with the results revealed from a study carried out in Taiwan, 2010 show that staff members aged between 31 and 40 or more than 40 years and staff members with more than five-year work experience displayed more susceptibility to the impact of noise on their work performance. In contrast administrators were less sensitive to the effect to the effect of noise on their work performance[18].

5. Conclusion

This study focuses on a specific issue of traffic noise that is it's impact on the medical care staff of hospitals in the city of Amman, the capital of Jordan.

The results of the study show that the average sound levels measured adjacent to three hospitals (AMC, IHH, and JUH) during daytime and nighttime were 70 and 68 dB (A), 70 and 67dB (A), and 72 and 72 dB (A), respectively. These values are much higher than the environmental daytime noise limit of 45 dB (A) and nighttime limit of 35 dB (A) required by the regulations in Jordan. The majority who were graduated from Jordanian universities, reported that about 43% of the Medicare givers always get annoyed by traffic noise. Early morning and afternoon are the most times of day when noise bothers hospital workers. 26% of the survey participants reported that they suffer a headache from high noise levels and 19% reported that traffic noise cause them difficulty in concentration, while 50% agree that traffic noise has an impact on performance. It can be deduced that noise pollution either directly or indirectly affects, in a simultaneous manner, the subjective perception of noise, emotion, physiology and experience of noise of the medical care staff.

6. Recommendations

The above conclusions reveal that hospitals in Amman suffer high levels of traffic noise which could have a negative impact on workers' and patients outcomes. It is very important that Medcare givers should provide a quite environment, for the staff and patients. This calls for the need to adopt the following recommendations:

- Increase public awareness in general on the importance of environmental protection projects and the effects of traffic noise on public health.
- Apply some mitigation measures along the existing main roads in order to reduce the effect of noise from outside hospitals. These measures may include:
  - Constructing noise barriers including earth berms between the hospitals and the main roads.

  - Providing effective noise insulation for the buildings.
  - Appling traffic management techniques that can reduce noise levels. For example, trucks can be prohibited from certain streets and roads, or they can be permitted to use certain streets and roads only during specific hours.
- Measures such as improving patients' visiting programs, preparing and distributing publicity materials, posting warning signs and providing noise control educational courses to medical and non-medical staff have proved to be effective in reducing noise levels inside hospitals and their implementation is commended for.

However, further research is recommended into this important issue through carrying out a more comprehensive study of noise levels inside and outside the hospitals in order to provide a more insight into the magnitude and characteristics of this serious environmental issue and to identify the most appropriate mitigation measures.

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