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COMMUNITY NOISE POLLUTION IN HOSPITAL AREAS OF KUALA LUMPUR, MALAYSIA

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ABSTRACT

This article identifies, describes, analyzes and assesses the outdoor community noise pollution (CNP) at Kuala Lumpur Hospital (KLH) and Tung Shin Hospital (TSH) in Kuala Lumpur. A type 1 sound level meter (SLM) was used in noise measurements. Questionnaire-interviews were conducted with the hospitals' staff to seek their perception and attitudes on CNP. Results are found to be consistent with noise measurement in terms of staff awareness of CNP and dissatisfaction of noise environment at their hospitals. Noise level in terms of equivalent continuous sound level for 16 hours (L_{eq16}) ranged between 72.4 and 80.3dB(A) at the KLH and between 76.8 and 86.6dB(A) at the TSH. These exceed the 45dB(A) level recommended by the World Health Organization (WHO) for outdoor hospital area. Finally, the results showed significant differences in noise level between KLH and TSH (P<0.001), and these may be due to the differences in land use pattern and traffic volume at the two sites.

Keywords : Noise pollution, hospital, perception, Kuala Lumpur.

INTRODUCTION

Community noise pollution (CNP) is one of the severe environmental problems in developed and semi-developed countries. Worldwide, noise-induced hearing impairment is the most prevalent irreversible occupational hazard and it is estimated that 120 million people worldwide have disability hearing difficulties (WHO, 2000). This depends on the value of equivalent sound level (L_{eq}); the number of noise-exposed years and on individual susceptibility.

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In the European Union, about 40% of the population is exposed to road traffic noise with an equivalent sound pressure exceeding 55dB(A) and 20% are exposed to level exceeding 65dB(A) during day time (WHO, 2000). Similar situation is found in the United States as a study has shown that excessive noise exposure is one of the leading causes of hearing loss for the twenty eight million people with impaired hearing (LHH, 2000). In Malaysia, similar situation also exists as is reflected by a study conducted by the Department of Environment (DOE) in Kuala Lumpur in 1993. It shows that noise level in terms of (L_{eq16}) reached up to 87dB(A). In a study conducted by Elfaig (2000) on noise level at selected schools compounds within the federal territory of Kuala Lumpur, it was concluded that noise level in terms of L_{eq16} ranged between 60dB(A) at the minimum level and 75dB(A) at the maximum level during schooling hours. Such noise level are expected to be found at the selected hospitals (KLH and TSH) since they are located near the main roads. These can affect task performance and patient recovery as it reduces the depth and quality of sleeping (Mehara et al., 1989).

Exposure to high noise level may results in at least momentary distraction and this may impair a person's ability to perform some task (Kavaler, 1975; Mehara et al., 1989). It may also cause damage to hearing mechanism, however, this depends on the overall noise level, the frequency composition of the noise, and the total duration of exposure. The critical effects of noise for most spaces in hospitals are sleeping disturbance, annoyance and communication interference, including warning signals. Accordingly, the World Health Organization in 1980 recommended 45dB(A) for outdoor noise level at sensitive area. The objectives of this article are: (1) to study the staff and workers perception towards CNP at their hospitals; (2) to determine and assess noise level at the selected hospitals areas at different day hours and to analyze the contributing factors; and (3) to suggest probable mitigation measures to abate such a problem.

MATERIALS AND METHODS

Two complementary methods were used to study CNP at the selected sites. These were the qualitative method to analyze and discuss respondents' perception on the problem domain and the quantitative one to identify the existing noise level.

Qualitative method

Survey structure (sample sites and size)

Two sample sites were selected deliberately, namely, the Kuala Lumpur Hospital (KLH) and Tung Shin Hospital (TSH) in Kuala Lumpur. These sites are located at the vicinity of busy roads. Questionnaire-interviews were conducted to elicit respondents' perception on the problem. Ninety persons were selected randomly. The Verbal Annoyance Scale (VAS) which is based on fuzzy logic techniques was used to measure affected people perception. The decision to use such a method was based on the effectiveness of such a scale in previous studies. Its less complex to construct and its reliability in the previous studies have been higher than more complex techniques (Langdon and Griffith, 1970; Chubb, 1981).

Statistical Package for Social Science (SPSS) was used for the analysis of respondents' perception. Frequency, percentage, mean and standard deviation were counted for. The main objective behind this was to get the individual subjective response on this problem.

Quantitative method

The rationale behind using this method was to get a quantitative noise measurement at the selected sites in terms of decibel and to determine the basic contributing factors to existing noise level.

Instruments and position

A hand tally counter was used to count the volume of traffic flow per hour. The vehicle population includes heavy trucks and buses, cars and motorcycles were counted simultaneously during measurements periods. A modular precision Sound Level Meter (SLM) type 1 and a Statistical Analyzer Module (SAM) were used to measure noise level. The SLM was calibrated at 93.8dB(A). The K factor of SLM was - 0.09. The SLM was posted at a height of 130 cm and at a distance of 200 cm and 300 cm from the fence of TSH and KLH, respectively.

Measured parameters and time intervals

The logarithmic and mathematical models applied to calculate noise levels were based on average and expression of sound level variation over time (equations 1-2).The measured parameters include L_{eq16}, sound level exceeded 90% of the measurement (L_{90}), sound level exceeded 50% of the measurement (L_{50}), minimum sound level (L_{min}), maximum sound level (L_{max}), sound level exceeded 10% of the measurement period (L_{10}) and sound level exceeded 1% of the measurement period ($L_{0.01}$). The measurements were taken for sixteen hours (7 a.m. to 10 p.m.) for four working days in June 1999. Each measurement lasted for five minutes with an interval of ten minutes. The results were an average of these measurements.

Where : $$L_{eq} = 10\log_{10}\frac{1}{T}\left[t_1 * 10^{\left(L_1/10\right)} + t_2 * 10^{\left(L_2/10\right)} + ...\right] \quad (1)$$

T is the time period for which sound level is described.

t_1, t_2 is the time for which the sound level is L_1, L_2, and so on.

Mathematically this equation can be shown as follows:

$$L_{eq} = L_{50} + \frac{(L_{10} - L_{90})^2}{56} \quad (2)$$

RESULTS AND DISCUSSION

Perception analysis

In analyzing, discussing, and evaluating the target group perception the demographic characteristics of respondents mentioned hereafter were selected and utilized to show respondents perception towards CNP. They were chosen as it is believed that people of different age, race, experiences, and educational levels are expected to have different perception and response to noise pollution. Results of these demographic characteristics are shown in Table 1.

Table 1. Characteristics of the respondents (n = 90).

Variable	Frequency	%
Gender:		
Male	25	27.8
Female	65	72.2
Age		
<20	13	14.4
20-30	35	38.9
31-40	26	28.9
>40	16	17.8
Educational level		
Secondary school	53	58.9
College and university	37	41.1
Occupation		
Medical officers/ physicians	29	32.2
Medical assistant/ nurses	55	61.1
Assistant managers	6	6.7
Race		
Malay	63	70
Chinese	15	16.7
Indian	11	12.2
Other	1	1.1
Years of experiences		
<1	19	21.1
1-3	33	36.7
3.1-5	12	13.3
>5	26	28.9

Data on race revealed that most of the respondents are Malay (70%), followed by Chinese (16.7%), Indian (12.2%), and other (1.1%). Results also showed that 14.4% are at the age below twenty years old, 38.9% aged between 20-30 years old, and 28.9% aged between 31-40 years old, while the remaining are at the age of forty years old or more. Results also spectacled that large segment of the respondents (58.9%) received secondary education and 41.1% are university and college graduates. For the occupational variable, the majority of respondents (61.1%) are medical assistants or nurses, 32.2% are medical officers or physicians and the remaining (6.7%) are assistant managers.

As far as the phrase "noise pollution" and noise environment as perceived by respondents are concerned, results are summarized in Table 2. The Table shows that three main factors explained 92.2% of the variation in the data set. These are unwanted loud sound, unwanted sound and loud sound that explained 47.8%, 33.3%, and 11.1% of the variation in the data set, respectively. A combination of unwanted sound and unwanted loud sound represents noise perception for both male and female. Within age groups most of the respondents (47.8%) perceived noise as unwanted loud sound especially among people aged between 20-30 years old. The same results can be applied to other selected demographic characteristics. No significant difference was obtained in the perception of respondents as the number of working years increase.

The Table reflects that 50% of the respondents classified their hospitals' areas either noisy or very noisy, while 47.8% mentioned that the areas are generally not bad in terms of noise pollution. These suggest that the respondents manifest their dissatisfaction with the attributes of the environment at the hospitals' areas. It also shows that female are most sensitive to noise, as 47.7% classified their areas as noisy or very noisy. It also shows that as old people are more sensitive to noise as 75% of the respondents whose age>40 years old classified the area as noisy or very noisy. The respondents identified three main variables that represent 84.5% of the variation in data set in terms of noise effects. These are interference with conversation (16.7%), concentration disturbance (25.6%) and noise affect ill people (42.2%) as the major symptoms of noise severity. Similar effects were identified by Kavaler (1975) as the most critical effects for most spaces in hospitals.

Results towards present situation show that four major factors contribute significantly to the existing noise level at outdoor hospitals' areas. These are small trucks (13%), large trucks (12.6%), cars (12.3%), and motorcycles (12.2%). Results showed that 43.9% of the respondents are unable to identify the exact sources of noise. This suggests that the existing of different factors that cause noise pollution.

Table 2. Respondents' perception and annoyance level in outdoor hospital areas (n = 90)

Variable	Noise perception				Annoyance level			
	Unwanted sound	Loud sound	Unwanted loud sound	Other	Very noisy	Noisy	Not bad	Quiet
Gender:								
Female	32	4	35	4	12	19	32	2
Male	8	6	8	3	4	10	11	
Age								
<20	5	2	4	2	2	6	5	0
20-30	7	2	24	2	7	6	22	0
31-40	13	4	7	2	4	8	12	2
>40	5	2	8	1	3	9	4	0
Educational level								
Secondary school	18	6	25	4	9	19	24	1
College/university	12	4	18	3	7	10	19	1
Occupation								
Medical officers/	12	7	7	3	7	8	13	1
physicians	15	3	34	3	8	19	27	1
Medical assistant/nurse	3	-	2	1	1	2	3	0
Assistant managers								
Race								
Malay	19	8	32	4	9	23	30	1
Chinese	7	2	4	2	3	1	10	1
Indian	3	0	7	1	3	5	3	0
Other	1	0	0	0	1	0	0	0
Years of experiences								
<1	8	2	7	2	3	8	8	0
1-3	9	2	21	1	6	8	19	0
3.1-5	4	2	5	1	2	3	5	2
>5	9	4	10	3	5	10	11	0

Experimental results

The average of measured noise parameters especially L_{eq16} at the KLH showed that noise level ranged between 72.4dB(A) at the minimum level and 80.3dB(A) at the maximum level (Figure 1), with an average of 77.8dB(A) and standard deviation of 2.5 during day hours (7 a.m- 22 p.m.). These levels exceed the 45dB(A) noise level recommended by the WHO for outdoor noise level at hospital areas. In numerical matters these levels exceed the recommended level by 72.4% at the minimum level and 78.4% at the maximum level. These levels may affect patient recovery, interference with speech and cause concentration disturbance. Results showed that not only L_{eq} was high but other measured noise parameters such as L_{min}, L_{max}, L_{50}, L_{10}, and $L_{0.01}$ were also high. As such noise level in terms of L_{10} ranged between 74.6 dB(A) at the minimum level and 82.5dB(A) at the maximum level with an average of 80.1dB(A) and standard deviation of 2.5. For other noise parameters see Figure 2.

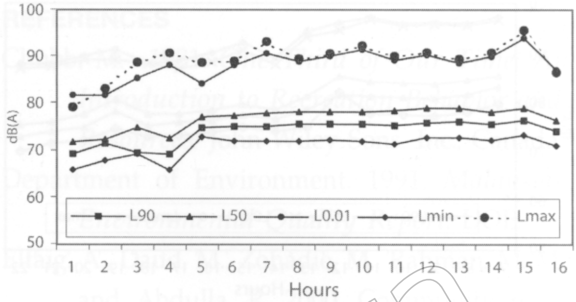

Figure 2. Measured noise parameters at Kuala Lumpur Hospital (1999).

Results also showed that the situation becomes worse at TSH area as the outdoor noise level in term of L_{eq} ranged between 76.8dB(A) at the minimum level and 86.6 dB(A) at the maximum level, as shown in Figure 3. These levels exceed the 45dB(A) level recommended by the WHO for outdoor sensitive areas such as hospitals. Results also showed that all other noise levels (L_{90}, L_{50}, L_{min}, L_{max}, $L_{0.01}$, and L_{10}) were also high (refer to Figure 4). For instance, L_{10} ranged between 79.5 dB(A) at the minimum level and 86.6 dB(A) at the maximum level, with an average of 81.5dB(A) and standard deviation of 3.3.

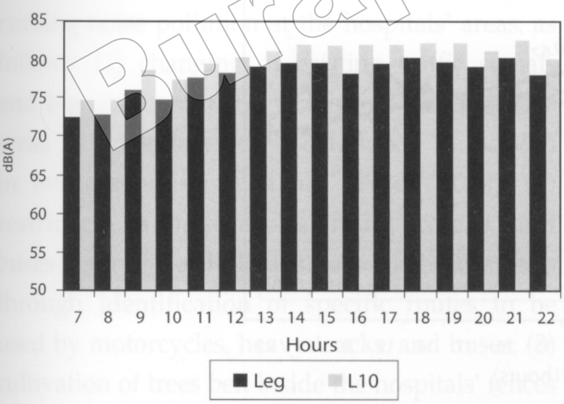

Figure 1. L_{eq} and L_{10} at Kuala Lumpur Hospital (1999).

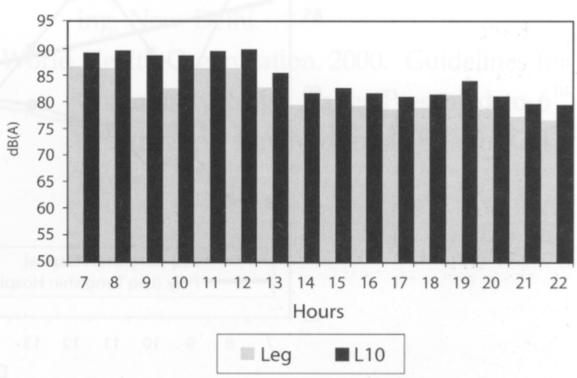

Figure 3. L_{eq} and L_{10} at Tung Shin Hospital (1999).

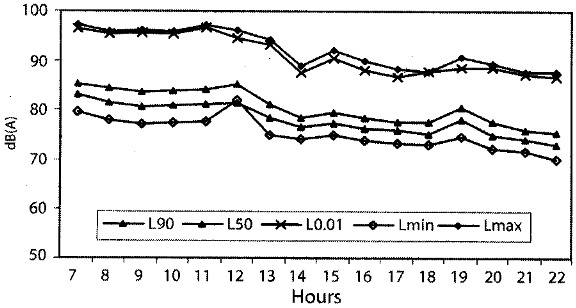

Figure 4. Measured noise parameters at Kuala Lumpur Hospital (1999).

The difference in the noise level between KLH and TSH over both space and time was found, as shown in Figure 5. It showed that the noise level at KLH was fluctuating significantly with r^2 of 0.67, while at TSH less fluctuations were observed ($r^2 = 0.90$). The differences in these noise level are significant ($\rho<0.001$). These were due to differences in traffic volume and distance between the major roads and the hospital fence, as shown Table 3 and Figures 5-7.

Table 3. Four days average of noise contributing factors at the selected sites (1999).

Site	Heavy trucks and buses	Cars	Motorcycles	Diastase to main road
Kuala Lumpur Hospital	295 unit/h	2315 unit/h	1121 unit/h	12 meter
Tung Shin Hospit	304 unit/h	2386 unit/h	1202 unit/h	5 meter

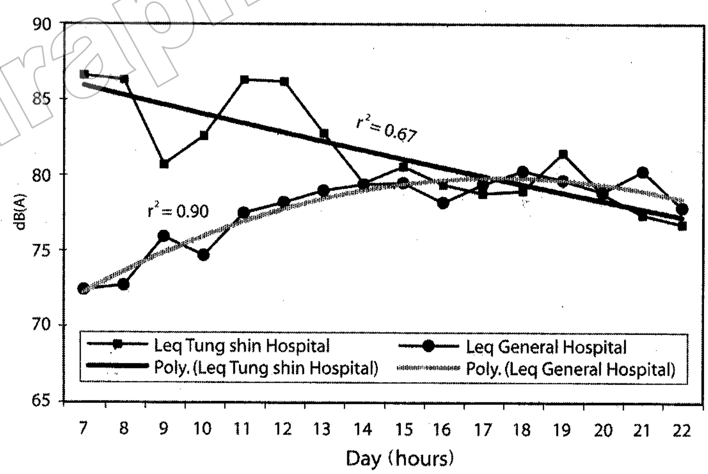

Figure 5. Comparison between the noise level at Kuala Lumpur Hospital and Tung Shin Hospital (1999).

It can be concluded that the existing noise level in term of L_{eq} in hospital areas of Kual Lumpur (Hospital Kuala Lumpur and Tung Shin Hospital) ranged between 72.4dB(A) to 86.6dB(A) during day hours. The effects of these levels on the patients and people working in the hospitals becomes worse in the absences of noise barriers and short distance between noise sources and hospitals (Table 3), coupled with the presence of traffic signals and bus station at the vicinity of hospitals that cause more noise as motor-mobile emits more noise pollution at the starting points. These levels may affect patient recovery, efficiency of staffs performance and interference with speech intelligibility (Mehara et al., 1989).

The study revealed that existing noise level highly exceed the 45dB(A) level recommended by the WHO for outdoor hospitals' areas by 70.6% and 72.4% at the minimum level for Kuala Lumpur Hospital and Tung Shin Hospital, respectively. This indicates that noise level was high during all day hours and highly fluctuated at Tung Shin Hospital and Kuala Lumpur Hospital. These may affect patients' recovery, task performance and interference with speech. The study suggests that the application of the following points help in curbing noise pollution at the hospitals' areas, as follows: (1) changing of existing traffic signals and bus stations at the vicinity of the hospitals' areas as noise level can be reduced by 3dB(A) in every doubling distance (From, 2000); (2) restriction of motorcycles, heavy trucks, and buses from using the roads pass by the hospitals through identification of specific routes to be used by motorcycles, heavy trucks, and buses; (3) cultivation of trees belt inside the hospitals' fences to act as a noise barrier; and (4) enforcement of regulations and laws relating to noise problem and reporting to authority.

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