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Assessment of occupational noise hazard in road ways and traffic intersections in Dhaka city

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Abstract

People working in the busiest of street environments are often exposed to high levels of noise as a part of their occupation and could be at the risk of noise induced auditory and psychological health effects. In Bangladesh, there is a dearth of data to realistically estimate the occupational noise exposure levels and, as a result, there is no reliable and comprehensive estimates of noise induced health hazard. Most studies regarding noise pollution in Bangladesh have focused on establishing spatial or spatio-temporal baseline at different parts of the country, yet none of them were interpreted from the point of view of occupational safety and health of working populations. This paper aims to build on that knowledge gap through a systematic study of noise exposure levels associated with two categories of working population who are exposed to noise as a part of their occupation: the road traffic police at intersections and the public bus drivers and helpers. A comprehensive temporal noise exposure database was generated by monitoring noise levels at ten of the busiest intersections in Dhaka and five different bus routes. Several noise exposure metrics were calculated to obtain an understanding regarding the nature of the noise exposed as well as to provide comparison with the permitted noise exposure levels in the Occupational Safety and Health Administration (OSHA) and National Institute for Occupational Safety and Health (NIOSH) guidelines. After correction for working shift, the range of noise exposure was found to be ranging from 88.4 dBA (Kawranbazar intersection) to as high as 94.3 dBA (G.P.O intersection) and these values were beyond the recommended safe levels of noise exposure. In the bus routes, similar to the intersections, all the noise levels were above the guideline values ranging from 86 dBA (Superlink operated route) to as high as 89.2 dBA (Moitri paribahan operated route). The noise level in these workplaces, though intermittent in nature, did not show any significant ‘peakiness’ characteristics as usually found in impulse-type noises in construction industry. This study points out the need of assessing the safety of workplace environment with respect to noise exposure and emphasizes that noise exposure criteria such as those outlined in OSHA or NIOSH guidelines must be adopted to ensure the health and well-being of workers working in noisy environments.

Keywords: noise exposure, occupational health and safety, noise pollution

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1. Introduction

Noise is considered one of the most common occupational hazards worldwide and the relationship between exposure to high levels of noise and Noise Induced Hearing Loss (NIHL) is well understood (NIOSH, 1998; ANSI, 1996). In general, a pattern of exposure to any source of sound that produces high enough levels can result in temporary hearing loss. If the exposure persists over a long period of time, this could lead to permanent hearing impairment (ANSI, 1996). NIHL has a profound physiological and social impact on affected individuals which eventually affects work performance, efficiency and reduces the quality of life (Sataloff et al, 1987). Additionally, noise pollution can cause annoyance and aggression, hypertension, high stress levels, tinnitus, hearing loss, sleep disturbances, and other harmful effects (Davis et al, 1998). In Bangladesh, the issue of noise pollution associated with increased traffic movement and construction activities in the urban environment has been raised in various corners (The Daily star, 2012) and it is widely suggested that people working in these environments may be suffering from NIHL and related ailments. Recent studies show high levels of noise in various points in the urban centres of Dhaka, Sylhet and Khulna (Ahmed, 1998; Das, 2001; WHO, 2002). However, noise is a variable quantity and point estimates for a particular time of the day may not represent the actual scenario for assessing the noise exposure of an individual in a particular work environment. To our knowledge, no research has been conducted in Bangladesh to realistically estimate the magnitude of occupational noise exposure levels and, as a result, there is a paucity of reliable and comprehensive estimates of the risk of NIHL associated with such exposure. Recent studies have found that the severity of the NIHL depends largely on whether the noise level exposed is intermittent or continuous (Hessel, 2000; Seixas et al., 2005). Recording the temporal variability of noise in the work environment is therefore necessary to make such an assessment.

It is suspected that in various workplace environments (e.g. textile industries, construction industries, traffic police, and roadside vendors) the noise exposure may be exceeding allowable levels. But in order to properly ascertain and address the situation, time-varying noise level measurements needs to be done in those workplaces. The temporal noise level measurement can be used to derive noise level intensity – duration relationships which can be compared with different occupational noise safety guidelines that are typically followed in the industries of the United States and worldwide (NIOSH, 1998; OSHA, 1983, see Tables 1 and 2). Although these guidelines have been in place for decades, the Department of Environment (DoE) in Bangladesh is yet to adopt similar safety standards for workplace environment in industries or elsewhere. Rather the area-wise noise limits stated in the Noise Control Rules, 2006 (DoE, 2006) is often applied as a proxy for workplace noise safety standards which is deemed largely inadequate in terms of ensuring a healthy workplace environment.

The primary objective of this study is to assess the occupational noise exposure hazard scenario in Bangladesh. Here we explore two different occupations in the road-traffic environment – the traffic police and the public bus drivers and conductors. This required collection of continuous noise level data in two different types of workplace environments in Dhaka city. The first one is at different intersections in the city where the city traffic police are exposed to noise as a part of their routine work shift. The second one is along different city bus routes where the conductors and drivers are exposed to high levels of noise as a part of their occupation. The collected data was summarized using different noise-level intensity metrics and was compared with existing international noise safety guidelines and standards by OSHA and NIOSH.

Table 1
NIOSH Guidelines for noise exposure in workplace (NIOSH, 1998)

Exposure Level dBA	Exposure Time
80	25 hours 24 minutes
81	20 hours 10 minutes
82	16 hours
83	12 hours 42 minutes
84	10 hours 08 minutes
85	08 hours
86	06 hours 21 minutes
87	05 hours 02 minutes
88	04 hours
89	03 hours 10 minutes
90	02 hours 31 minutes
Upto 140	< 1 second

Table 2
OSHA Guidelines for noise exposure in workplace (OSHA, 1983)

Duration per day, Hours	Sound level Exposure dBA
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105
0.5	110
0.25 or Less	115

Note: When the daily noise exposure is composed of two or more periods of noise exposure of different levels, their combined effect should be considered, rather than the individual effect of each. If the sum of the following fractions: C(1)/T(1) + C(2)/T(2) + C(n)/T(n) exceeds unity, then, the mixed exposure should be considered to exceed the limit value. C(n) indicates the total time of exposure at a specified noise level, and T(n) indicates the total time of exposure permitted at that level. Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level.

2. Methods

2.1 Site selection

The study of noise level in the traffic intersections in this study is aimed towards assessing the noise exposure of the traffic police stationed at the intersections typically working in shifts of 8 hours. During their shifts thousands of vehicles cross junctions, honking horns, which are the main sources of noise at these locations. Temporal noise level measurements were made in 10 of the busiest intersections in Dhaka city namely G.P.O, Shapla chattar, Bijoy sarani, Shahbag, Farmgate, Dainik Bangla, Kakoli, Kawranbazar, Mowchak and Asadgate intersections. In each intersection, noise level measurements were made for around one hour during peak periods at 30 second intervals. The traffic police were also interviewed in order to understand their perception regarding the noise level. Table 3 gives the description of these road intersections.

In order to assess the noise exposure of the bus drivers and conductors, five bus routes were selected for noise level measurement which are as follows: Mohammadpur to Arambag

Table 3
Descriptions of the road intersections

Intersections	Measurement time	Descriptions	No. of attending Traffic Policemen
G.P.O	5:00 p.m-6:00 p.m	Four legged intersection	3
Shapla chattar	4:40 p.m-5:40 p.m	Situated at the heart of the busiest commercial area of Dhaka	5
Bijoy sarani	5:50 p.m-6:50 p.m	Important intersection in northern hub of Dhaka	4
Shahbag	10:30 a.m-11:30 a.m	Very busy intersection during office hours	3
Farmgate,	9:30 a.m-10:30 a.m	Important via route for majority of public bus services, generates a lot of traffic due to its commercial importance	3
Dainik Bangla	5:50 p.m-6:50 p.m	Four legged intersection and congestion during peak hours	2
kakoli	4:30 p.m-5:30 p.m	A critical intersection in the northern hub of Dhaka	2
Kawranbazar	9:30 a.m-10:30 a.m	A very big intersection with a roundabout and five roadways. Traffic controlling is complicated here.	5
Mowchak	4:30 p.m-5:30 p.m	A four legged crowded intersection in the mid town area of Dhaka	2
Asad gate	4:45 p.m-5:45 p.m	Three legged intersection connected to the widest road of Dhaka city i.e. Manik-mia avenue.	2

Table 4
Descriptions of the public bus routes

Bus company	Bus route	Time for a single one-way trip (minutes)	No. of buses in the route	Route distance (km)	Average no. of trips per day
Moitri Paribahan	Mohammadpur to Arambag via Gulistan	77	20	6.8	5
Falgun bus service	Azimpur to Uttara via Rampura	101	25	18.4	4
Suchona BRF	Azimpur to Uttara via Farmgate	118	20	15.5	4
Bahon Paribahan ltd.	Mirpur 14 to Taltola	93	18	14.3	5
Superlink bus service	Mohammadpur to Dhupkhola	86	27	15.2	5

(Moitri Paribahan Company), Azimpur to Uttara via Rampura (Falgun bus service), Azimpur to Uttara via Farmgate (Suchona BRF), Mirpur 14 to Taltola (Bahon Paribahan ltd.) and Mohammadpur to Dhupkhola (Superlink bus service). Table 4 gives description of the bus routes in this study. It was found that their working shifts are not constant due to the delay in road caused by traffic congestion. Their shifts usually exceed 8 hours. Therefore, a shift correction was applied to get the noise exposure over an equivalent 8 hour working shift. (Section 3.2, for details).

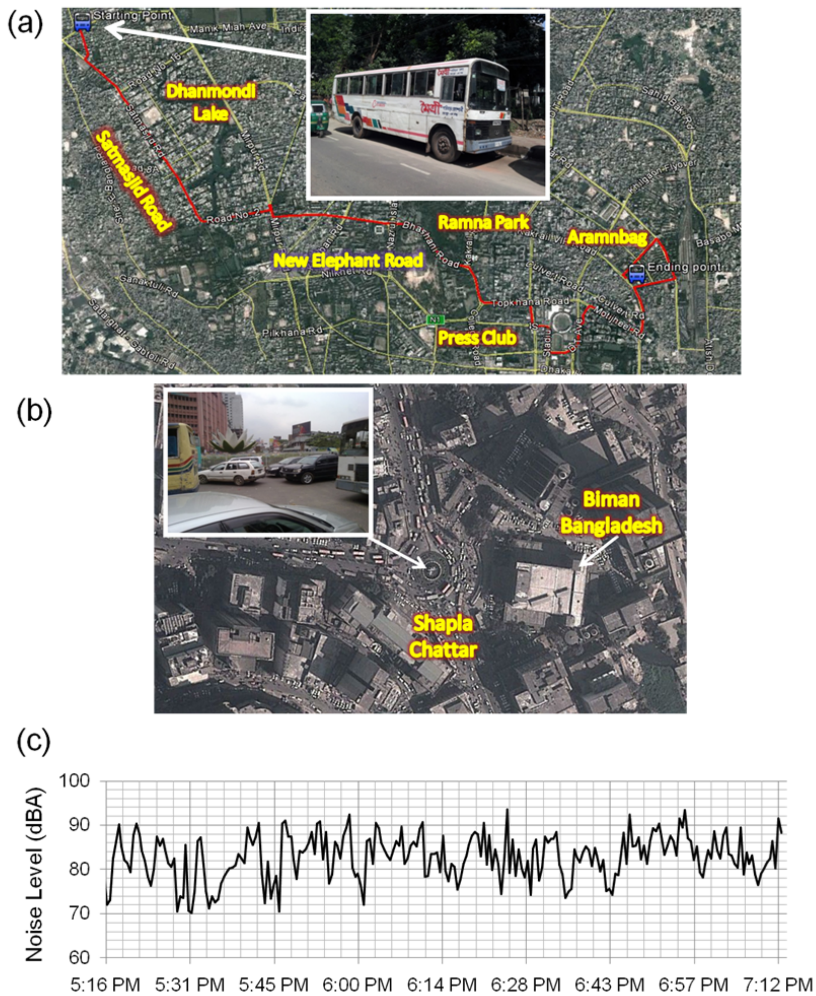

Fig. 1. (a) Delineation of the Moitri Bus route from Mohammadpur to Arambag via Gulistan. During peak hours, due to traffic congestion completing this route takes almost two and a half hours during which the noise level measurements were made. (b) Shapla Chattar intersection location where the noise level measurements were made. (c) A two- hour record of noise level (in dBA) along the Suchona BRF bus route showing the variation of noise exposure as experienced by the bus conductor and driver.

2.2 Data collection

The noise monitoring data was collected using a calibrated Extech 407735 digital sound level meter. The probe was held at the height of the receptors' ear level. Manual recording of data was performed and a stop-watch was used to record the time. The dataset generated from the noise levels was extensively checked for errors and adjusted accordingly by omitting from the dataset.

Figure 1(a) shows outline of one of the bus routes in the study (Motri Paribahan). Figure 1(b) shows the location of one of the intersections (Shapla Chattar) in this study from where the noise level data was collected. Figure1(c) shows the temporal noise level profile in the Suchona BRF bus route.

3. Data analysis

3.1 Noise intensity-duration relationship for bus routes and intersections

In order to characterize the noise levels in different intersections and bus routes, cumulative noise distributions (see Figures 2 and 3) were constructed from the temporal noise profiles. These distributions indicate the percentage of time a certain noise level is equaled or exceeded within the sampling time. As mentioned earlier, the sampling was done during peak hours of traffic and hence represents the worst case scenario. As shown in Figure 2, the noise level in the GPO, Bijoy Sarani and Kakoli intersections showed a wide distribution with the maximum noise level often exceeding 100 dBA. In Farmgate, Bijoy Sarani and Shahbag intersections, the noise levels were found to be constantly high exceeding 85 dBA at 84%, 82% and 92% of times respectively. In the rest of the intersections, 85 dBA sound level was exceeded in moderate degrees ranging from 46% to 74%. The 90 dBA exposure limit has been exceeded in various degrees with as low as 16% in Kawranbazar intersection to as high as 64% in Shahbag intersection. The 85 dBA and 90 dBA are exposure limits for 8 hour/day working shift in NIOSH and OSHA guidelines respectively.

The noise levels in the bus routes were somewhat less severe compared to the intersections. As shown in Figure 3, The route operated by Falgun bus service experienced the widest range of noise levels with as high as 101.7 dBA while the Moitri bus route experienced a constantly high level of noise with 67% of time exceeding the 85 dBA limit. In the other routes, the exceedence probability ranged from 32% to 45%. The percentage of time exceeding the 90 dBA limit were found to be within 4% and 22% which were lower than that of the intersections.

3.2 Computation of noise level metrics for bus routes and intersections

Three main exposure metrics were used to summarize the variable noise exposures: L_{eq}, $L_{avg,,}$ L_{max}. The L_{eq} and L_{avg} represent average levels integrated over a 1 min period and L_{max} represents the highest maximum level measured during the same period. Most scientific and regulatory agencies rely on the equivalent continuous noise level (L_{eq}) to assess NIHL risk; this metric is generally regarded as the most protective measure of continuous, intermittent and impact noise (NIOSH, 1998). However, US regulations specify use L_{avg}, which incorporates a less protective time–intensity exchange rate (5 dB, as opposed to 3 dB for the L_{eq}). (Seixas et al 2005). The metrics were calculated using the following formulae (Seixas et al 2005);

$$L_{ij} = q\log 10\left[\left(\frac{1}{M_{ij}}\right)\sum_{k=1}^{n_{ij}} w_{ij} 10^{(L_{ij}k/q)}\right] \quad (1)$$

where, L_{ij} is the level of noise for an individual i for a specific task j, summarized over the time interval, k = 1 to n_{ij}. L_{eq} (or L_{rms}), also known as equivalent steady sound level of a noise energy-averaged over time, is estimated with q = 10 while L_{avg} is calculated with q = 16.6 (Earshen, 2000). The L_{max} was noted from the noise level data. The time intervals used were mostly 1 min or in some cases they were half a minute.

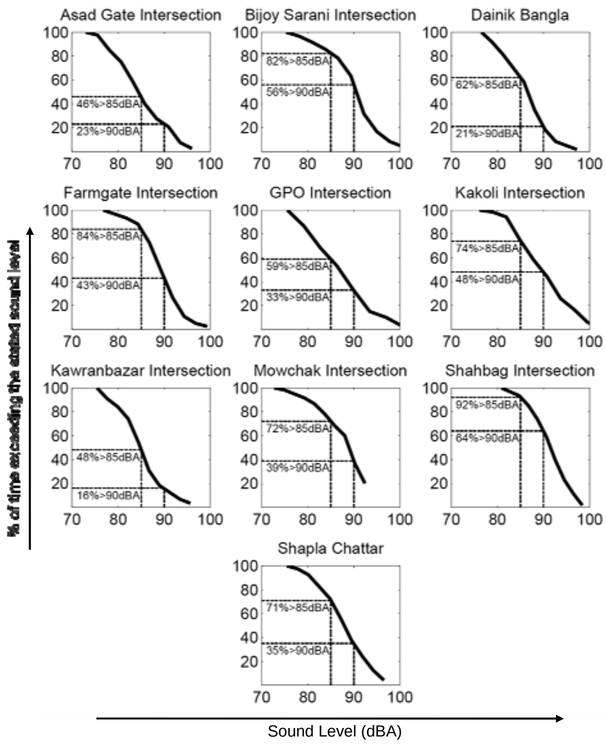

Fig. 2. Cumulative noise level distribution in ten different intersections of Dhaka City; The percentage of times the noise level exceeding 85 dBA and 90 dBA are also shown.

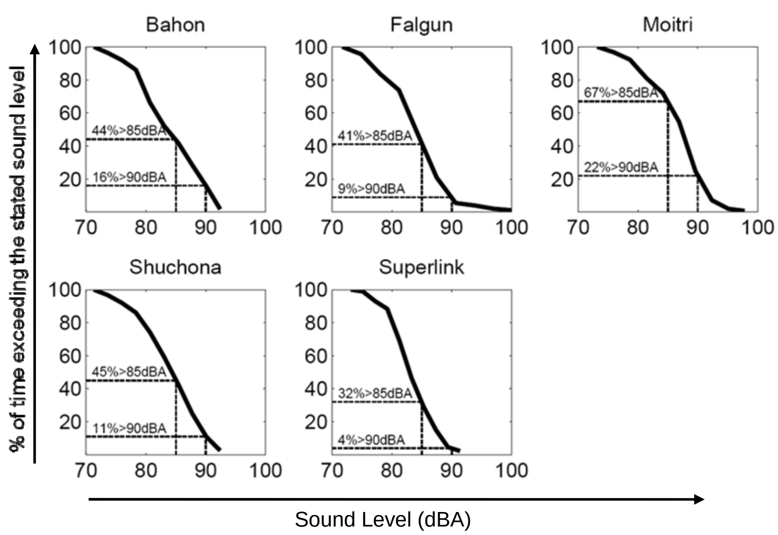

Fig. 3. Cumulative noise level distribution in five different bus routes of Dhaka City; The percentage of times the noise level exceeding 85 dBA and 90 dBA are also shown.

The noise level data of the road intersections resulted in L_{eq} values which were all close to 90 dBA. The worst case scenario was at the G.P.O intersection where the L_{eq} was 92.8 dBA. Over all the intersections the L_{avg} was ~2.5 dBA less than $L_{eq,}$ while L_{max} was ~10 dBA higher than L_{eq}. On the other hand the L_{eq} values of the public bus routes were within the range of 83-87.5 dBA. The highest L_{eq} was measured in the Mohammadpur to Arambag via Gulistan route operated by Moitri paribahan which was 87.5 dBA. In general, the bus routes registered a L_{avg} value which was ~1.2 dBA less than L_{eq}, while L_{max} was ~11 dBA higher than L_{eq}.

Two other noise level metrics derived from these measured noise levels, L_{eq}/L_{avg} (coefficient of variability) and L_{max}/L_{eq} (coefficient of peakiness), known as measures of exposure variability and 'peakiness' respectively, were also used. Peak exposures are common in some work settings, and exposure to impulse noise may be more damaging than longer exposure to lower level sounds of the same total energy. (Seixas et al 2005). Therefore it would be interesting to observe the presence of 'peakiness' in the measured noise levels in the intersections and bus routes using these quantities. In Table 5 and 6 the calculated quantities of L_{eq}/L_{avg} and L_{max}/L_{eq} for the intersections and bus routes which were derived from the noise level data shows values close to 1 which indicates that there was a very steady level of noise in the intersections and the bus routes and very low peakiness in noise levels. This maybe because honking of horns and vehicular movement generate a relatively steady level of noise as opposed to other work settings such as construction sites where the generated noise is impulse-type. Since the noise levels are relatively steady, another noise level metric L_{mean} can be applied in this case. L_{mean} is sometimes useful to combine steady sound levels regardless of their time of duration (WorkSafeBC, 2007). Equation 2 shows how L_{mean} is calculated.

$$L_{mean} = \frac{(L_1+L_2+L_3+\dots+L_n)}{n} \quad (2)$$

Table 5
Noise level Metrics for the Road intersections
(representing noise exposure on traffic police officials).

Intersections	L_{mean} (dBA)	$L_{eq}=L_{rms}$(dBA) [SD]	L_{max}(dBA)	L_{avg}(dBA) [SD]	L_{eq}/L_{avg}	L_{max}/L_{eq}
G.P.O	85.2	92.8[10.5]	109.5	89.5[8.5]	1.037	1.223
Mowchak	86.5	88.7[5.7]	93.5	88.1[8.8]	1.007	1.054
Dainik Bangla	85.1	88.0[5.7]	98.4	86.9[5.3]	1.013	1.118
Shapla chattar	86.8	89.6[5.9]	97.7	88.6[5.5]	1.011	1.091
Shahbag	90.4	92.2[4.6]	99.4	91.6[4.3]	1.006	1.085
Farmgate	87.9	90.4[5.2]	100.6	89.4[4.9]	1.011	1.113
Kakoli	88.4	92.6[7.3]	104	90.9[6.5]	1.018	1.123
Kawranbazar	83.9	86.9[5.7]	96.8	85.7[5.2]	1.014	1.114
Bijoy Sharani	88.8	92.4[6.9]	102	91.1[6.2]	1.014	1.104
Asad gate	83.6	87.6[7.1]	97.3	86.0[6.3]	1.018	1.110

Table 6
Noise level Metrics for the Public Bus Routes
(representing exposure on drivers and conductors)

Public Bus	L_{mean} (dBA)	$L_{eq}=L_{rms}$(dBA) [SD]	L_{max}(dBA)	L_{avg}(dBA) [SD]	L_{eq}/L_{avg}	L_{max}/L_{eq}
Moitri Paribahan	85	87.5 [5.5]	99.2	86.6[5]	1.01	1.13
Falgun bus service	82.2	86.5[6.8]	101.7	84.5[5.8]	1.02	1.17
Suchona BRF	82.8	85.3[5.6]	93.6	84.4[5.3]	1.01	1.09
Bahon Paribahan	82.6	85.5[6]	93.6	84.5[5.7]	1.03	1.09
Superlink bus service	82	83.7[4.2]	92.4	83.1[4]	1	1.1

where, L_i = the i-th sound level of n number of sound level measurements. The L_{mean} of Shahbag intersection was found to be 90.4 dBA while in the rest of the intersections L_{mean} was found to be around 86-88 dBA. In the public bus routes the L_{mean} was around 82-83 dBA with the exception of Moitri bus route which showed the highest L_{mean} of 85 dBA.

The standard deviations are also calculated for all the recorded noise levels in the bus routes and intersections (Table 5 and 6). The standard deviation with respect to L_{eq} is of significance as it shows the spread of the noise level measured. Analysis of the standard deviations reveals that the GPO intersection had the most variability in terms of L_{eq} and L_{avg} (92.8±10.5dBA and 89.5±8.5 dBA respectively). In case of public bus routes, the deviations were all quite similar with the Falgun bus having the highest deviations in both L_{eq} and L_{avg} (86.5±6.5 and 84.5±5.8 respectively).

3.2 Calculation of noise dose and shift exposure

For comparison with NIOSH (Table 1) and OSHA (Table 2) guidelines, the actual noise exposure (L_{EX}) needs to be determined. L_{EX} is the sound level, energy-averaged over 8 hours, which would give the same daily noise exposure dose as the varying noise over a typical full shift and is useful as a single number measure of the noise exposure in decibel form. It is closely related to the L_{eq} which was estimated in the study. In fact, L_{EX} could be regarded as being the measured L_{eq} with a small correction as shown in the following equation. (WorksafeBC, 2007):

$$L_{EX} = L_{eq} + \text{correction for shift length} \quad (3)$$

The correction for shift length can be obtained from the chart as shown in Figure 4. Along with the L_{EX} the Noise dose can be found. Noise dose is another single descriptor for noise exposure and may be given in terms of a value relative to unity or 100%. An exposure to sound level 85 dBA for 8 hours corresponds to a 100% noise dose which is termed as an“acceptable”amount of noise according to the NIOSH guidelines. Also, noise calculations can be made simpler by using noise dose values instead of sound levels in decibels. For example, in discussing noise exposures, it is more convenient to see that a noise dose of 160% (87 dBA for 8 h) exceeds the permissible 100% dose (85 dBA for 8 h). Noise dose can be calculated using the following equation:

$$\text{Noise Dose} = 100 \times T/8 \times 10^{(L_{eq}-85)/10} \ \% \quad (4)$$

where, L_{eq} = A-weighted, sound level linearly energy averaged over T hours and T = the sampling time, in hours.

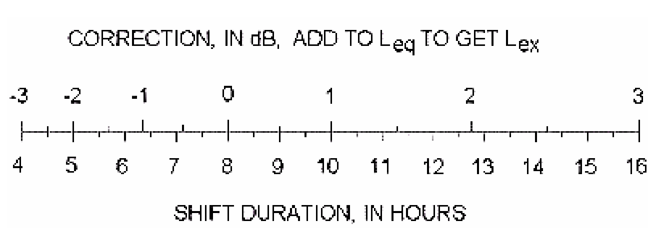

Fig. 4. Correction for Shift Length to get L_{EX}
(Source: WorkSafeBC (2007))

For all intersections and traffic roadways L_{EX} and Noise dose are determined and presented in Tables 7 and 8 respectively. From tables 7 and 8 the noise level comparison for different work sites with NIOSH and OSHA guidelines can be done. In the intersections and the bus routes the L_{EX} values exceeded both the guidelines. All the intersections produced values well over the recommended noise exposure level. The range was as low as 88.35 dBA (Kawranbazar intersection) to as high as 94.25 dBA (G.P.O intersection). In the bus routes, similar to the intersections, all the noise levels were above the guideline values with as low as 86 dBA (Superlink operated route) to as high as 89.2 dBA (Moitri paribahan operated route).

Table 7
Comparisons of intersections noise level with NIOSH and OSHA guidelines

Intersections	L_{EX} (dBA)	Noise Dose (%)	Actual Average Shift Length (hr)/day*	Permitted Shift Length (hr)/day (NIOSH)	Permitted Shift Length (hr)/day (OSHA)	Comments (guideline exceeded)*
G.P.O	94.25	850	11.2	55 min	2 hr 25 min	NIOSH & OSHA
Mowchak	90.25	330	11.2	2 hr 31 min	3 hr 48 min	NIOSH & OSHA
Dainik Bangla	89.45	275	11.2	3 hr 10 min	4 hr 18 min	NIOSH
Shapla chattar	91.05	400	11.2	2 hr	3 hr 41 min	NIOSH & OSHA
Shahbag	93.65	750	11.2	1 hr 16 min	2 hr 35 min	NIOSH & OSHA
Farmgate	91.85	480	11.2	1 hr 45 min	2 hr 56 min	NIOSH & OSHA
Kakoli	94.05	820	11.2	1 hr	2 hr 17 min	NIOSH & OSHA
Kawranbazar	88.35	220	11.2	3 hr 40 min	4 hr 50 min	NIOSH
Bijoy sarani	93.85	750	11.2	1 hr 10 min	2 hr 26 min	NIOSH & OSHA
Asad gate	89.05	250	11.2	3 hr 10 min	4 hr 6 min	NIOSH

*Note: *Average Shift length (hr/day) of traffic police is 11.2 hr/day. The guidelines have set standards for receptors working 5 weekdays. The traffic police are assigned for 7 days a week for 8 hours shift/day. Therefore the shift hours of the traffic police has been converted to an equivalent 5 day period which results in a 11.2 hr shift per working day. The shift correction according to figure 4 is +1.45.*

Table 8
Comparisons of bus routes noise level with NIOSH and OSHA guidelines

Bus	L_{EX} (dBA)	Noise Dose (%)	Actual Average Shift Length (hr)/day	Permitted Shift Length (hr)/day (NIOSH)	Permitted Shift Length (hr)/day (OSHA)	Comments (guideline exceeded)*
Moitri Paribahan	89.2	270	6 hr 25 min	2 hr 55 min	4 hr 10 min	NIOSH
Falgun service	88.5	225	6 hr 44 min	3 hr 25 min	4 hr 25 min	NIOSH
Suchona BRF	88	200	7 hr 52 min	4 hr	5 hr 10 min	NIOSH
Bahon Paribahan	88.3	210	7 hr 45 min	3 hr 46 min	4 hr 40 min	NIOSH
Superlink service	86	125	7 hr 10 min	6 hr 21 min	7 hr 40 min	NIOSH

*Note: *Guideline for noise exposure, 1) For 8 hr working hour/day NIOSH limits 85 dBA L_{EX} value and noise level of 100%. 2) For 8 hr working hour/day OSHA limits 90 dBA L_{EX} value.*

From the analysis of the noise data it was found that noise level at the intersections had high variability mainly due to the presence of random traffic movement and hydraulic horns used by vehicles. The noise descriptors showed that the noise level in all the intersections was above the NIOSH limits while five of the ten intersections were found to be exceeding the

OSHA guidelines. In the analysis of the noise data in the public bus routes of Dhaka, high variability was found as well. The descriptors showed that none of the noise levels failed the OSHA guidelines, however they all failed the NIOSH guidelines.

4. Discussion

In order to assess the noise environment pertaining to certain working groups such as traffic police and city bus conductors/drivers, temporal noise level data was collected in two types of working environments which included road traffic intersections and travel routes of local city buses. After assessing the quality of noise environment through several noise level metrics and comparing with OSHA and NIOSH guidelines, it was found out that the expected exposure levels of noise was very high in all of the intersections/travel routes surveyed and the people working in these environments are probably at risk of developing noise-induced ailments. As a matter of fact, the people who work in these environments for certain periods during the day (e.g. 8-hour shifts of traffic police, 8 – 12 hours working periods for bus conductors/drivers) are likely to be more affected than temporary occupants of the streets such as hawkers, travelers or passers-by. This study assesses the noise exposure received by the rather permanent occupants whose occupation compels them to remain in this environment as a part of their job. Indiscriminate honks by different classes of vehicles, nearby construction activities etc. are primarily responsible for high levels of noise in these study locations. In this study, the busiest time period of the day was chosen to represent the noise environment in order to assess the worst case scenario. The intensity of noise, of course, will vary during different parts of the day depending on traffic and other activities. Therefore, the data presented in this study would generally reflect the noise exposure received by the particular working group during the peak hours of the day.

The current noise standards in the ECR 1997 or Noise Control Rules, 2006 are largely inadequate to serve the purpose of curbing noise pollution in the busiest of city environments as the source of pollution is diverse and difficult to control. For example, changes in driving behavior to refrain from excessive honking is a must to reduce noise pollution and probably can only be controlled through general awareness or specific enforcement mechanisms (fines, penalties etc.). On the other end, from the receptors point of view, noise exposure criteria such as those outlined OSHA or NIOSH guidelines must be adopted to protect the health of workers working in such environments. This study provides a necessary starting point for occupational health and safety assessments with respect to noise environment in the context of Bangladesh and emphasizes the need for extensive follow-up studies in order to ascertain the true extent of the problem.

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