A Study of Measuring Transportation Induced Noise Pollutions near Hospitals

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PROJECT REPORT

APPROVAL

The thesis titled "**A Study of Measuring Transportation Induced Noise Pollutions near Hospitals**" submitted by Kazi Motasimul Kabir and Fahim Shahrukh St. No. 145430, 145453 have been found as satisfactory and accepted as fulfillment of the requirement for the Degree Bachelor of Science in Civil Engineering

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DECLARATION OF CANDIDATE

We hereby declare that the undergraduate research work reported in this thesis has been performed by us under the supervision of **Dr. Shakil Mohammad Rifaat** and this work has not been submitted elsewhere for any purpose (except for publication).

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DEDICATION

We dedicate our thesis work to our family. A special feeling of gratitude to our loving parents.

We also dedicate this thesis to our many friends who have supported us throughout the process. We will always appreciate all they have done.

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"*In the name of Allah, Most Gracious, Most Merciful*"

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ABSTRACT

The source of outdoor noise worldwide is mainly caused by machines, transport and transportation systems. Poor urban planning may give rise to noise pollution, side-by-side industrial and residential buildings can result in noise pollution in the areas that have hospitals. The patients go to the hospital for treatment, they need full rest and sound environment. But the hospitals that are situated near the highways fall victim to noise pollution. So the noise level in front of the hospitals need to be reduced. The main objective of the study is to Measure the noise conditions of hospitals adjacent to national highways. It also deals with the average value of the collected data which will be compared to the standard suggested value by different organizations. Four specific hospitals in front of Highways were chosen to collect data and four different times were chosen to collect data in different days of a week. T test analysis has been used for the analysis of the data. A device named Noise Level Meter has been used to collect data. In case of comparing the data among the hospitals there were no significant variation but in case of comparing among different times in a day there were several significant changes were observed. The study can compare the collected transportation induced average noise level with local as well as WHO suggested standard. This study also helps the policy makers and law enforcers to take necessary steps to reduce noise level.

LIST OF SYMBOLS

H_0	The Null hypothesis
H1	The Alternate Hypothesis
μ_1	An Average Noise of a Population
μ_2	An Average Noise of another Population
t	A Test Statistic for a Difference between Two Population Means and Variances
n_1	The Sample Size of Population 1
n_2	The Sample Size of Population 2
Sp2	Population Variance
$\overline{x_1}$	Sample Mean 1
$\overline{x_2}$	Sample Mean 2
(1-α) 100%	Confidence Interval

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CHAPTER 1: INTRODUCTION

1.1 Background

With the increasing population and intensive land use huge traffic demand is generating worldwide. As a matter of fact, severe congestion, lack of safety, environment pollution etc. are very common phenomena now-a-days. Among them the most severe problem that we face daily is the noise pollution. Sound pollution, also known as environmental noise, is the propagation of noise with harmful impact on the activity of human or animal life. The source of outdoor noise worldwide is mainly caused by machines, transport and transportation systems (Hogan and Latshaw, 1973). Poor urban planning may give rise to noise pollution, side-by-side industrial and residential buildings can result in noise pollution in the residential areas (Nwasinachi and Agunwamba, 2015). The main sources of noise in residential area are loud music and loud barking by domestic dogs. It can also be loud talking or shouting by humans although this last is less persistent. Noise pollution associated with household electricity generators is an emerging environmental degradation in many developing nations. The average noise level of 97.60 dB obtained exceeded the WHO value of 50 dB allowed for residential areas. Research suggests that noise pollution is the highest in low-income and racial minority neighborhoods (Casey et al., 2017).

High noise levels can contribute to cardiovascular effects in humans and an increased incidence of coronary artery disease (Hoffmann et al., 2006). In animals, noise can increase the risk of death by altering predator or prey detection and avoidance, interfere with reproduction and navigation, and contribute to permanent hearing loss (2015). While the elderly may suffer from cardiac problems due to noise, children also suffer from it and can suffer permanent damage for life (WHO). According to the World Health Organization children are especially vulnerable to

noise. Noise poses a serious threat to a child's physical and psychological health, including learning and behavior (EPA, 2015).

Noise pollution affects both health and behavior. Unwanted sound (noise) can damage psychological and physiological health. Noise pollution can cause hypertension, high stress levels, tinnitus, hearing loss, sleep disturbances, and other harmful effects (Rosen and Olin, 1965. Field, 1993. WHO. BBC news, 2009).

Sound becomes unwanted when it either interferes with normal activities such as sleep or conversation, or disrupts or diminishes one's quality of life (Jefferson and Catrice, 2013). Noise induced hearing loss can be caused by outside (e.g. vehicles) or inside (e.g. music) noise.

Chronic exposure to noise may cause noise-induced hearing loss. Older males exposed to significant occupational noise demonstrate more significantly reduced hearing sensitivity than their non-exposed peers, though differences in hearing sensitivity decrease with time and the two groups are indistinguishable by age 79 (Rosenhall et al., 1990). A comparison of Maaban tribesmen, who were insignificantly exposed to transportation or industrial noise, to a typical U.S. population showed that chronic exposure to moderately high levels of environmental noise contributes to hearing loss (Rosen and Olin, 1965).

High noise levels can result in cardiovascular effects and exposure to moderately high levels during a single eight-hour period causes a statistical rise in blood pressure of five to ten points and an increase in stress and vasoconstriction leading to the increased blood pressure noted above, as well as to increased incidence of coronary artery disease.

Less addressed is how humans adapt to noise subjectively. Indeed, tolerance for noise is frequently independent of decibel levels. However, Murray Schafer's soundscape research was ground-breaking in this regard. In his eponymous work, he makes compelling arguments about how humans relate to noise on a subjective level, and how such subjectivity is conditioned by culture (Schafer and Murray, 1977). He also notes that sound is an expression of power, and as such,

material culture (e.g., fast cars or Harley Davidson motorcycles with aftermarket pipes) tend to have louder engines not only for safety reasons, but for expressions of power by dominating the soundscape with a particular sound. Other key research in this area can be seen in Fong's comparative analysis of soundscape differences between Bangkok, Thailand and Los Angeles, California, US. Fong's research methodology was modeled after Schafer, and the research findings show how not only do soundscapes differ, but they also rather explicitly point to the level of urban development in the area; that is, cities in the periphery – in Immanuel Wallerstein-speak – will have different soundscapes than that of cities in the core. Fong's important findings tie not only soundscape appreciation to our subjective views of sound, but also demonstrates how different sounds of the soundscape are indicative of class differences in urban environments (Fong and Jack, 2014).

1.2 Objectives

The objectives of this study are:

- Measure the noise conditions of hospitals adjacent to national highways.
- The noise condition will also be compared among different hospitals at different times & days of the week.
- The average value of the collected data will be compared to the standard suggested value by different organizations.

1.3 Scope of the Research

The study will examine the effects of different noise characteristics of the different hospitals using linear regression model. Some of the mentionable scopes are:

- Four specific hospitals in front of Highways were chosen to collect data.
- A device named NOISE METER was used to collect the data.
- Data was collected at different times and days of the week.
- The Average noise value of the total data are calculated.
- Using T test, it is found out whether there are significant difference between the means that were collected.
- The data collected in front of the different hospitals has helped the study to conclude whether it follows Environment Conservation Rule'97 (ECR'97) or not.
- As the ECR'97 is not followed then for creating awareness a street sign will be fixed in front of the hospitals.

1.4 Significance

This study will contribute to the research literature in several ways:

- In Bangladesh no significant studies had been done about noise level of hospitals adjacent to highway.
- It was compared with the Standard & Current Scenario was revealed.
- The Policy Makers, Law Enforcers & Law Implementers can be greatly assisted through this study by taking necessary actions to reduce the noise level near hospitals.

1.5 Possible Results

- Finding out whether there are any statistical difference between noise levels of two hospitals adjacent of highways.
- Finding out whether there are any statistical difference between noise level of the Hospitals in different times and days of a week.

1.6 Practical Implication

Here are the practical implication of the study:

- We can compare the collected transportation induced average noise level with local as well as WHO suggested standard.
- After comparing the values , the policy makers and law enforcers can take necessary steps to reduce noise such as
    - Fixing road sign
    - Constructing speed breakers
    - Imposing fines if any laws are violated
    - Not using hydraulic horn in front of hospitals

1.7 Outline of the Thesis

The thesis is organized into six chapters. After the introduction in first chapter, the other five chapters will cover the following topics:

Chapter 2- **Literature Review**

Factors which are affecting vehicle noise (specially in hospital zone) explored in previous studies are reviewed in this chapter. Important information and finding from these studies are also documented. Moreover the effect of different times and different days as well as different types of roads are also focused on this chapter.

Chapter 3-**Data and Methodology**

Chapter three describes the sites of the database used in this study as well as methodology followed in T-Test analysis with the collected data. This chapter also discusses the comparative noise studies of hospital zone on the basis of various highways and time difference.

Chapter 4- **Data Analysis and Comparative Studies**

Chapter four describes the details of data analysis. The comparative study is shown here considering transportation induced noise in different time, different days of week and different highways.

Chapter 5-**Results and Interpretation**

All the results obtained from the analysis are stated here. Explanation of the results is discussed rigorously in this chapter.

Chapter 6-**Conclusions and Recommendations**

This chapter draws final conclusion based on the findings of comparative noise levels of hospital zone. Some directions for future exploration of research in this area are also mentioned. There is some highly considerable information for the policy makers about present situation of hospital zone on the basis of transportation induced noise and some guide line is provided for reducing transportation induced noise in hospital zone.

Chapter 2: LITERATURE REVIEW

2.1 Definition of Noise

In simple terms, noise is unwanted sound. Sound is a form of energy which is emitted by a vibrating body and on reaching the ear causes the sensation of hearing through nerves. Sounds produced by all vibrating bodies are not audible. The frequency limits of audibility are from 20 HZ to 20,000 HZ. A noise problem generally consists of three inter-related elements- the source, the receiver and the transmission path. This transmission path is usually the atmosphere through which the sound is propagated, but can include the structural materials of any building containing the receiver.

Noise may be continuous or intermittent. Noise may be of high frequency or of low frequency which is undesired for a normal hearing. For example, the typical cry of a child produces sound, which is mostly unfavorable to normal hearing. Since it is unwanted sound, we call it noise.

The discrimination and differentiation between sound and noise also depends upon the habit and interest of the person/species receiving it, the ambient conditions and impact of the sound generated during that particular duration of time. There could be instances that, excellently rendered musical concert for example, may be felt as noise and exceptional music as well during the course of the concert!

Sounds of frequencies less than 20 HZ are called infrasonic and greater than 20, 0000 HZ are called ultrasonic.

2.2 Physics of Sound

I. **Sound, Noise, Acoustics**

Sound is a vibratory disturbance created by a moving or vibrating source, in the pressure and density of a gaseous, liquid medium or in the elastic strain of a solid which is capable of being

detected by the hearing organs. Sound may be thought of as mechanical energy of a vibrating object transmitted by pressure waves through a medium to human (or animal) ears. The medium of main concern is air.

Noise is defined as (airborne) sound that is loud, unpleasant, unexpected or undesired, and may therefore be classified as a more specific group of sounds. Perceptions of sound and noise are highly subjective: one person's music is another's headache. The two terms are often used synonymously, although few would call the sound that originates from a highway anything but noise.

Acoustics is the field of science that deals with the production, propagation, reception, effects, and control of sound. The field is very broad, and transportation related noise and its abatement covers just a small, specialized part of acoustics.

II. **Frequency, Wavelength,**

The number of times per second that the wave passes from a period of compression through a period of rarefaction and starts another period of compression, is referred to as the *frequency* of the wave.

The distance traveled by a sound pressure wave through one complete cycle is referred to as the *wavelength*. The duration of one cycle is called the *period*. The period is the inverse of the frequency. For instance, the frequency of a series of waves with periods of 1/20 of a second is 20 Hertz; a period of 1/1000 of a second is 1000 Hz, or 1 KHz. As the frequency of sound pressure waves increases, their wavelength shortens, and vice versa. The relationship between frequency and wavelength is linked by the speed of sound, as shown in the following equation:

$\lambda = c/f.$

Where:

λ = Wavelength (m or ft)

c = Speed of Sound (343.3 m/s, or 1126.5 ft/sec at 20o C, or 68o F)

f = Frequency (Hertz)

In the above equations, care must be taken to use the same units (distance units in either meters or feet, and time units in seconds) for wavelength and speed of sound. Although the speed of sound is usually thought of as a constant, we have already seen that it actually varies with temperature.

The above mathematical relationships hold true for any value of the speed of sound. Frequency is normally generated by mechanical processes at the source.

2.3 Measurement of Noise Level

There is a wide range of instrumentation available for the measurement and analysis of highway noise. Some units, such as a hand-held sound level meter (SLM), can provide simple noise level data without the necessity for laboratory data reduction. To obtain records of data representing long periods of time, it is frequently advantageous to have data recorded and analyzed in a laboratory. The highway planner, however, will seldom have available equipment more complex than the hand-held SLM.

In addition to the SLM, a calibrator, microphone windscreen, and stopwatch will be necessary to perform adequate measurements. To ensure sufficient precision, the meter should be certified as a Type I or Type II sound level meter according to ANSI Standard SI.4-1971.[1] Further, the meter should be capable of measuring noise levels ranging from 35 to 100 dB. The meter and microphone should be calibrated prior to making the measurements and again when the measurements have been completed. The microphone windscreen is necessary to reduce wind noise and to protect the microphone from moisture and dust. A stopwatch or clock with a readable sweep-second hand will be required to time the meter readings.

2.4 Sources of Noise

Major causes / sources of noise pollution are**:**

I. Industrial Sources:

Progress in technology (industrialization) has resulted in creating noise pollution. Textile mills, printing presses, engineering establishments and metal works etc. contribute heavily towards noise pollution. In industrial cities often the industrial zones are not separated from the residential zones of the city especially in the case of small scale industries.

These operate from workshops located on the ground floors of the residential areas and cause annoyance, discomfort and irritation to the residents exposed to the noise that is inevitably produced. The situation is much better in modern planned cities where the industrial area is kept away from the residential areas and both are separated from each other by a sufficiently wide green belt.

II. Transport Vehicles:

Automobile revolution in urban centers has proved to be a big source of noise pollution. Increasing traffic has given rise to traffic jams in congested areas where the repeated hooting of horns by impatient drivers pierce the ears of all road users.

Noise from airplanes constitutes an increasing serious problem in big cities. Airport situated in the vicinity of population centers and the air planes pass over residential areas. Heavy trucks, buses trains, jet-planes, motor-cycles, scooters, mopeds, jeeps—the list of vehicles is endless but the outcome is same — noise pollution**.**

III. Household:

The household is an industry in itself and is a source of many indoor noises such as the banging of doors, noise of playing children, crying of infants, moving of furniture, loud conversation of the inhabitants etc. Besides these are the entertainment equipment in the house, namely the radio, record-players and television sets. Domestic gadgets like the mixer-grinders, pressure cookers, desert coolers, air- conditioners, exhaust fans, vacuum cleaners, sewing and washing machines are all indoor sources of noise pollution.

IV. Public Address System:

In Bangladesh people need only the slightest of an excuse for using loud speakers. The reason may be a religious function, birth, death, marriage, elections, demonstration, or just commercial advertising. Public system, therefore, contributes in its own way towards noise pollution.

V. Agricultural Machines:

Tractors, thrashers, harvesters, tube wells, powered tillers etc. have all made agriculture highly mechanical but at the same time highly noisy. Noise level 90 dB to 98 dB due to running of farm machines have been recorded.

VI. Defense Equipment:

A lot of noise pollution is added to the atmosphere by artillery, tanks, launching of rockets, explosions, exercising of military airplanes and shooting practices. Screams of jet engines and sonic booms have a deafening impact on the ears and in extreme cases have been known to shatter the window panes and old dilapidated buildings.

VII. Miscellaneous Sources:

The automobile repair shops, construction-works, blasting, bulldozing, stone crushing etc. are other sources of noise pollution.

2.5 Noise Measurement Instruments

Many types of measuring systems can be used for the measurement of sound depending on the purpose of the study, the characteristics of sound and the extent of information that is desired about the sound. The various elements in a measuring system are:

a. The transducer; that is, the microphone
b. The electronic amplifier and calibrated attenuator for gain control
c. The frequency weighting or analyzing possibilities
d. The data storage facilities
e. The display.

Not all elements are used in every measuring system. The microphone can, for instance, be connected to a sound level meter or directly to a magnetic tape recorder for data storage and future measurement or reference.

2.6 Effects of Noise

Noise is generally harmful and a serious health hazard. It has far-reaching consequences and has many physical, physiological as well as psychological effects on human beings**.**

a) Physical Effects:

The physical manifestation of noise pollution is the effect on hearing ability. Repeated exposure to noise may result in temporary or permanent shifting of the hearing threshold of a person depending upon the level and duration of exposure. The immediate and acute effect of noise pollution is impairment of hearing (i.e. total deafness.)

Human ears have sensory cells for hearing. If these cells are subjected to repeated sounds of high intensity before they have an opportunity to recover fully, they can become permanently damaged leading to impairment of hearing. Besides the sensory cells, the delicate tympanic membrane or the ear drum can also be permanently damaged by a sudden loud noise such as an explosion.

b) Physiological Effects:

The physiological manifestations of noise pollution are several as mentioned below:

(a) Headache by dilating blood vessels of the brain.

(b) Increase in the rate of heart-beat.

(c) Narrowing of arteries.

(d) Fluctuations in the arterial blood pressure by increasing the level of cholesterol in the blood.

(e) Decrease in heart output.

(f) Pain in the heart.

(g) Digestive spasms through anxiety and dilation of the pupil of the eye, thereby causing eye-strain.

(h) Impairment of night vision.

(i) Decrease in the rate of color perception.

(j) Lowering of concentration and effect on memory,

(k) Muscular strain and nervous breakdown.

(l) Psychological Effect

c) Psychological Effects:

(a) Depression and fatigue which considerably reduces the efficiency of a person.
(b) Insomnia as a result of lack of undisturbed and refreshing sleep
(c) Straining of senses and annoyance as a result of slow but persistent noise from motorcycles, alarm clocks, call bells, telephone rings etc.
(d) Affecting of psychomotor performance of a person by a sudden loud sound
(e) Emotional disturbance

For a talkative person, the most important effect of noise pollution would invariably be that noise interferes with our conservation. So, noise is annoying and the annoyance depends on many factors not merely the intensity of the sound but also repetition, because even a sound of small intensity (e.g. dripping tap or clicking of clock) may become annoying, simply by repetition.

2.7 Control of Noise Pollution

Following are some good ways to control noise pollution:

i. **Noise-Free Electronic Appliances:** The appliances which are noise-free are easily available in the market. We just have to pay few more money to buy those products. If we don't do this, then we have to pay more than this to doctors for the treatment of the weakening nerves and hearing.
ii. **Use of Headphone for TV and Music:** It sounds weird but if one person wants to listen to music in the loud voice why others pay its price.
iii. **No Honking in Front of Home:** When one reaches at home the sound of the engine of his vehicle is enough to let his house-mates know about his arrival. He needs not honk and disturb others.
iv. **Noiseless Office Appliances:** The voice of Printer and photocopier are equally irritating if it keeps coming all the time. So its alternate is to buy noiseless office appliances and be safe from the harms of noise pollution that ranges from making one deaf to cause any coronary problem for him.

v. **Keep Your Fingers Touched on the Keyboard:** While typing if one creates noise by touching his fingers loudly with a keyboard that is also a little noise pollution. So, he should keep his fingers touched over the keyboard and help keep the office environment calm down.

vi. **Intercom the Best Way of Internal Communication:** Even one sits with his colleagues in a big hall it is less noisy to talk to them on the intercom that is also a corporate way of speaking at the workplace.

vii. **No Honking in a Residential Area:** One has to switch his horn little thorny so that whenever he pushes it he feels thorns over his thumb. In this way, you he push it in case he must have to honk to warm anyone.

viii. **Open Air Dance Parties Must be Avoided:** We can enjoy our life and it is our right but not at the cost of others peace. So one should arrange his open-air dance parties by playing music with less sound or headphone to each guest is also an ideal option that is gradually getting popular in most of the advanced countries.

ix. **The Silencer of a Vehicle in Good Condition:** We must keep the silencer and engine of our vehicle in good condition to let minimum noise emit from it while it is moving.

x. **No Music While Driving, Just Important News in Low Tones:** It is mentioned in traffic rules, that listening music is prohibited. Yes, we can listen to the news on the radio to get ourselves updated about our surroundings.

CHAPTER 3: DATA and METHODOLOGY

3.1 Introduction

In this chapter, discussion about data collection and methodology adopted for the analysis of noise variations at different hospitals has been introduced. The selection of sources and collection of data used for this study are described first and then the mathematical formulation of the selected statistical discussed. The key steps in the methodology are followed by the theoretical framework of unpaired t-test for both equal and unequal variances used in this study. The development of these analysis will assist us to understand how noise of different hospitals changes with respect to time and location.

3.2 Site Selection

For better understanding the noise characteristics of hospitals in highways it is necessary to study on several sites. However, due to limitation of resources we have considered four sites.

We have chosen 4 specific hospitals in front of 2 highways.

From

Dhaka-Mymensingh Highway	Tairunnesa Memorial Hospital
	Imperial Hospital
Dhaka-Aricha Highway	Enam Medical College Hospital
	Ibrahim General Hospital

We had chosen two days in a week (1 Weekday & 1 Weekend)

For 4 times in a day Morning – 8:00-10:00 AM

Noon – 12:00-2:00 PM

Evening – 4:00-6:00 PM

Night – 9:00-11:00 PM

3.3 Data Calculation

We have calculated the data using T-Test. It helped us to get the data in three ways, which are:

- Comparison of Avg. Noise Between Different Time Periods of Weekdays & Weekends
- Comparison of Avg. Noise Between Days for a Particular Hospital
- Comparison of Avg. Noise Between Different Hospitals at the Same Time

3.3.1 Data Collection Procedure

We have used Noise Level Meter for measuring the noise level of different hospitals near selected highways. The work was carried out through 2 different days in a week. It included starting day of the week that means Sunday and Friday as ending day of the week.

3.4 Statistical Analysis Method

T-test has been used to differentiate between two average sounds.

The null and the alternate hypothesis of two average speed μ_1 and μ_2 of two population are as follows:

Ho: $\mu_1 - \mu_2 = 0$ … … … (3.4.1)

H1: $\mu_1 - \mu_2 = 0$ … … … (3.4.2)

A test statistic for a difference between two population means with equal variances is given by

$$t^* = \frac{(\overline{x_1} - \overline{x_2}) - (\mu_1 - \mu_2)}{\sqrt{s_p^2(\frac{1}{n_1} + \frac{1}{n_2})}} \quad \ldots \ldots \ldots (3.4.3)$$

Where, the term ($\mu 1 - \mu 2$) is the difference between $\mu 1$ and $\mu 2$ under the null hypothesis.

The sample size of population 1 and population 2 are n_1 and n_2 respectively.

The degrees of freedom of the test statistic in this equation are (n1 - n2 + 2), which are the degrees of freedom associated with the pooled estimate of the population variance S_p^2

$$s_p^2 = \frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2} \quad \ldots \ldots \ldots (3.4.4)$$

The confidence interval for a difference in population means is based on the t distribution with (n1-n2 + 2) degrees of freedom. A (1-α) 100% confidence interval for the difference between two population means (μ1 - μ2)

Here we assume equal population variances is

$$\overline{x_1} - \overline{x_2} \pm \sqrt{s_p^2(\frac{1}{n_1} + \frac{1}{n_2})} \ldots \ldots \ldots (3.4.5)$$

CHAPTER 4: RESULTS and DISCUSSION

4.1 Introduction

Noise data has been taken for Car, Bus, Truck, Pickup, CNG, Motor cycle, Mini Van, Rickshaw, Bicycle in four weekdays Data were taken for morning peak (8.00a.m-10.00a.m), noon peak(12.00p.m-2.00p.m), afternoon peak (4.00p.m- 6.00p.m) and night peak (9p.m-11p.m)for each day.

Unpaired t-tests were used depending on the hypothesized results. For example a two-tailed t-test was used to compare morning and afternoon noise. Because of the large sample sizes, very small differences appear as statistically significant. This causes need to discuss in terms of practical significance. Taking 90% confidence as the cut point, if the analysis of noise differences shows value <0.1, the difference was considered practically significant. Similarly, there were some statistical interactions between variables, however, they were not practically significant; therefore, the interactions will not be discussed.

Taking 90% confidence as the cut point while differentiating between means (for both equal and unequal population variances), three analyses is performed by using **STATA**:

- Comparison of Avg. Noise Between Different Time Periods of Weekdays & Weekends
- Comparison of Avg. Noise Between Days for a Particular Hospital
- Comparison of Avg. Noise Between Different Hospitals at the Same Time

4.2 Comparison of Avg. Noise between Different Time Periods of Weekdays & Weekends

Average Noise comparison between different time periods of Weekdays & Weekends of four different hospitals are shown below in the table:

Table 4.1: Comparison of Avg. Noise between Different Time Periods of Weekdays & Weekends

Time1 Vs Time2 (Particular Day) M=Morning N=Noon A=Afternoon E=Evening	**P value (For equal variance)**	**Statically Significant= O Statically Insignificant= X**	**P value (For unequal variance)**	**Statically Significant= O Statically Insignificant= X**
A VS E (WD) Enam	0.0027	0	0.0029	0
M VS A (WD)	0.0001	0	0.0001	0
M VS E (WD)	0.0001	0	0.0001	0
M VS N (WD)	0.0085	0	0.0085	0
N VS A (WD)	0.1344	X	0.1358	X
N VS E (WD)	0.3295	X	0.3324	X
A VS E (WE)	0.0097	0	0.009	0
M VS A (WE)	0.0015	0	0.0015	0
M VS E (WE)	0.8028	X	0.8107	X
M VS N (WE)	0.5585	X	0.5546	X
N VS A (WE)	0.7922	X	0.8162	X
N VS E (WE) Enam	0.0237	0	0.0293	0
A VS E (WD) Ibrahim	0.9249	X	0.9281	X
M VS A (WD)	0.0547	0	0.066	0
M VS E (WD)	0.4753	X	0.485	X
M VS N (WD)	0.0207	0	0.0206	0
N VS A (WD)	0.4228	X	0.4224	X
N VS E (WD)	0.0432	0	0.0411	x
A VS E (WE)	0.0027	0	0.0029	0
M VS A (WE)	0.001	0	0.0001	0
M VS E (WE)	0.0001	0	0.0001	0
M VS N (WE)	0.0085	0	0.0085	0
N VS A (WE)	0.1344	X	0.1358	X
N VS E (WE) Ibrahim	0.3295	X	0.3324	X

A VS E (WD) Imperial	0.0097	0	0.009	0
M VS A (WD)	0.0015	0	0.0015	0
M VS E (WD)	0.8028	X	0.8107	X
M VS N (WD)	0.5585	X	0.5546	X
N VS A (WD)	0.7922	X	0.8162	X
N VS E (WD)	0.0237	0	0.0293	0
A VS E (WE)	0.9249	X	0.9281	X
M VS A (WE)	0.0547	0	0.066	0
M VS E (WE)	0.4753	X	0.485	X
M VS N (WE)	0.0207	0	0.0206	0
N VS A (WE)	0.4228	X	0.4224	X
N VS E (WE) Imperial	0.0432	0	0.0411	x
A VS E (WD)Tairunnesa	0.0027	0	0.0029	0
M VS A (WD)	0.0001	0	0.0001	0
M VS E (WD)	0.0001	0	0.0001	0
M VS N (WD)	0.0085	0	0.0085	0
N VS A (WD)	0.1344	X	0.1358	X
N VS E (WD)	0.3295	X	0.3324	X
A VS E (WE)	0.0097	0	0.009	0
M VS A (WE)	0.0015	0	0.0015	0
M VS E (WE)	0.8028	X	0.8107	X
M VS N (WE)	0.5585	X	0.5546	X
N VS A (WE)	0.7922	X	0.8162	X
N VS E (WE) Tairun	0.0237	0	0.0293	0

From Table 4.1 it is observed that on weekdays, average noise level at night varies with the other three time periods of morning, noon & evening beside highways. At night when it is closing time of hospitals there is a noticeable number of personal vehicles is shown near the hospital areas. Most of the hospital of Bangladesh don't have specific parking zone. As a result the vehicles are parked on the road. So the effective width of road decreases. On the other hand all institutions such as industries, offices, banks close almost at the same time at evening. As a result the traffic volume is higher in that period and this high volume of traffic have to pass through a narrow width of road at hospital areas.

On weekends the average noise level significantly changes at afternoon and evening times. Most of the people go out from the house in order to going markets or visiting relative's houses. Apart from that, at other time periods noise level varies insignificantly.

4.3 Comparison of Avg. Noise between Days for a Particular Hospital

Average Noise comparison between days for a particular hospital of four different hospitals are shown below in the table:

Table 4.2: Comparison of Avg. Noise between days for a particular hospital

Time1 Vs Time2 **(Particular Day)** **E = Enam** **Ib = Ibrahim** **Im = Imperial** **T = Tairunnesa**	**P value** **(For equal variance)**	**Statically Significant= O** **Statically Insignificant= X**	**P value** **(For unequal variance)**	**Statically Significant= O** **Statically Insignificant= X**
WD VS WE (E)	0.1344	X	0.1358	X
WD VS WE (Ib)	0.0547	0	0.066	0
WD VS WE (Im)	0.0015	0	0.0015	0
WD VS WE (T)	0.0237	0	0.0293	0

From the above table it is seen that noise level of each hospital for weekdays and weekend changes significantly in case of Ibrahim medical, Imperial medical and Tairunnesa medical. As these hospitals lie adjacent to very busy roads. But in case of Enam medical this noise level doesn't vary significantly as it lies somewhere away from the highway.

4.4 Comparison of Avg. Noise between Different Hospitals at the Same Time

Average Noise comparison between Different Hospitals at the Same Time of four different hospitals are shown below in the table:

Table 4.3: Comparison of Avg. Noise between Different Hospitals at the Same Time

Time1 Vs Time2 **(Particular Day)** **E = Enam** **Ib = Ibrahim** **Im = Imperial** **T = Tairunnesa**	**P value** **(For equal variance)**	**Statically Significant= O** **Statically Insignificant= X**	**P value** **(For unequal variance)**	**Statically Significant= O** **Statically Insignificant= X**
E VS Ib VS Im VS T (WD)	0.8028	X	0.8107	X
E VS Ib VS Im VS T (WE)	0.5585	X	0.5546	X

From the above table it is seen that after taking all the hospitals in account there is no significant changes in noise level both for weekdays and weekends. The reason behind is both the highways are on the two major busy roads. So there is less variety of vehicle variations in these highways.

CHAPTER 5: CONCLUSION

5.1 Introduction

The principal objective of this study is to identify the factors affecting transportation noise at hospital zone which would be helpful for identifying road safety conditions near hospital areas. In order to achieve this objective, various factors from effect of starting and closing hour of hospital , traffic flow and vehicle occupancy, road infrastructure, mode of transportation , driver related factors , environmental and visibility, type of roads have been investigated. . To establish average noise Comparison of Avg. Noise between Different Time Periods of Weekdays & Weekends, Comparison of Avg. Noise between Days for a Particular Hospital & Comparison of Avg. Noise between Different Hospitals at the Same Time, unpaired t-test analysis was utilized. Several factors have come out to be significant in each case study. Many of these significant factors are found common in specific comparative study. This chapter gives an overview of the important findings of this research. The findings are discussed in detail based on their effects on variation of average transportation induced noise in hospital zones are considered in the study. This is followed by suggestions for precautionary measures to be taken to enhance noise condition near hospital zones as well as suggestions for future research.

5.2 Summary and Conclusion

From this study we observed that that average transportation induced noise depends on different time period of different days and different types of highway. It is also observed that the average noise of the same road varies from day to day and time to time.

This study tries to explain the reasoning of noise differentials. Special safety measures should be taken to improve the driving condition of the road particularly emphasizing on certain time periods or days. By analyzing the data and observed results, some recommendations have been drawn for the policy makers. Some general requirements are discussed based on the key findings from our analysis.

This study have some important findings like on Sunday, average noise of vehicles at evening varies with the other three time periods of morning, noon and night beside highways; On typical weekday, the average vehicle noise at evening peak of hospital zones varies significantly with the other three periods of morning, noon and night & also on Friday the average vehicle noise at noon varies significantly with night, evening and morning for the hospital zones near highway.

Statistically significant differences are observed for average noise while comparing between "Sunday and Typical weekday" & between "Typical weekend and Friday".

We also found significant difference in the average noise varies significantly between highways.

Comparing with other methods the benefit of this study is that without having any noise history preventive measures can be taken on potential noise sites for avoiding future noises.

5.3 Recommendation

By analyzing the data and observed results, some recommendations have been drawn for the policy makers. Some general requirements are discussed based on the key findings from our analysis.

The irregular road crossing tendency of pedestrian is much higher in Highways which initiates the noise of vehicles near hospital zones beside highway roads. Serviceable footpath should be ensured for the safe movement of pedestrian at hospital zones specially beside highway roads. Ample zebra crossing and foot over bridges should also be provided.

The average vehicle noise varies significantly between highways. The smaller vehicles (eg. rickshaw, auto, CNG etc.) are less in numbers on highway. As slow-moving vehicles have a great effect on the vehicle flow of entire road, it is necessary to manage their flow. A different lane for slow-moving vehicles can solve this problem.

On Sunday, average noise of vehicles at evening varies with the other three time periods of morning, noon and night beside highways. At night hour the noise of vehicle is less than the other three time periods. Because at night when it is closing time of hospital there is a noticeable number of personal vehicles is shown near the hospital zone which are waiting for the patients and doctors. Most of the hospitals near highways of Bangladesh don't have specific parking zone. For the parking of personal vehicles the roads besides hospitals have been almost blocked. It has a great effect on normal vehicle flow. To solve this problem specific parking zone for every hospital is needed.

The average vehicle noise at noon increase significantly with night, evening and morning for the hospital zones. It is observed that an adequate number of traffic police is not available at noon, as a result the drivers operate their vehicle carelessly and over speed take place. Therefore, proper monitoring is required for all time periods.

The average vehicle noise varies significantly in highways. As the vehicle noise is much higher in highways, one of the reason is the street hawkers and food vans are available in a large number at some Highways. They also create little blockage of road width, which affects the vehicle speed. Specific space should be provided for the hawkers and food vans. Thus it will prevent the unexpected blockage of road width which will help the drivers not to use their hydraulic horns and cause noise pollution.

According to our observation, the number of buses increases on highway and on the other hand the volume of rickshaw, autos and private vehicles increases near the hospital zones on Thursday. Awareness should be raised among the everyone about the safe crossing of roads near hospital

zones specially on the last day of the week when the vehicle flow is much higher. Some awareness increasing program should be arranged by hospital authority to create knowledge about road safety among everyone.

5.4 Limitations

The research has been conducted considering several limitations. In this study, the sample size is limited and noise data has been collected for only two days.

Some variables that might have significant effect on variation of average noise are omitted due to lack of data which is an inborn problem in many applied research.

The finding of this study would be much more strengthened if there were more observation; however, due to limited manpower and budgetary constraint it was not possible to collect more data.

Several road infrastructure features i.e. number of lanes, sound limit, road width have not been considered for this study. Apart from the above mentioned variables frequency of transit, driver characteristics, pedestrian behavior, trip purpose, transit network, parking price were not incorporated in the study.

Driver characteristics and behavior affect the noise in hospital zones and should be introduced in future studies. It is these drivers that particular attention must be paid to through either more draconian enforcement or physical countermeasures within the road environment to reduce the opportunity so noise can also be revealed by this survey.

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