Proceedings of the 4th International Conference on Civil Engineering for Sustainable Development (ICCESD 2018), 9~11 February 2018, KUET, Khulna, Bangladesh (ISBN-978-984-34-3502-6)

DETERMINATION OF NOISE LEVEL AT RAJSHAHI MEDICAL COLLEGE HOSPITAL AND NEARBY ROAD

Md. Niamul Bari[1], Noosrat Rashid[2] and Samia Sultana[3]

[1] Department of Civil Engineering, RUET, Bangladesh, e-mail: niamulbari@gmail.com
[2] Department of Civil Engineering, RUET, Bangladesh, e-mail: noosrat.pushpo@gmail.com
[3] Department of Civil Engineering, RUET, Bangladesh, e-mail: samia.ora2012@gmail.com,

ABSTRACT

Noise pollution's adverse effect on human is undeniable and it is particularly detrimental for patients in hospitals as it averts their healing process. Since public hospitals in Bangladesh are exposed to a noticeable sound pollution, this study seeks to reveal the intensity of internal noise and impact of nearby roads noise of Rajshahi Medical College Hospital. In this study, noise level was measured in 11 different types of wards and their nearby roads during 2 work-days and 1 holiday from 8am to 8pm at a 30 minute interval by a digital sound level meter. By analyzing the data for both maximum and minimum noise levels, the average noise level yielded nearly double of allowable limit (WHO standard: 45 dB). The maximum noise levels measured in Child, Medicine, Nephrology, Cardiology, Neurosurgery, Orthopedic, Neuromedicine, Surgery, Gynecology, Burn unit, and Post-operative ward were of 81.3 dB, 82.3 dB, 77.5 dB, 79.3 dB, 80.5 dB, 81.2 dB, 74.8 dB, 78.4 dB, 79.4 dB, 78.3 dB, 75.7 dB, respectively. Even the ICU's maximum average noise level was found to be of 74.2 dB, which is far above the WHO standard (35 dB). It was observed that rather than noise from nearby roads, the noise pollution was occurring mainly due to an excess of patients, screaming, instrumental alarm, meal-time noise, moving trolleys etc. The study suggested that the facilities should be vigilant about enforcing rules regarding patient capacities and building codes, and adopt building designs that favors patients' privacy and reduce noise levels. Furthermore, attendants and visitors should exercise more self-restraint.

Keywords: *Noise level, pollution, hospital, indoor, WHO standard*

1. INTRODUCTION

For the time being after air and water pollution noise is figured out as the third most hazardous pollution of big cities according to World Health Organization (WHO) statement. Noise can be described as an intolerable amount of sound which has a detrimental effect on environment. Kryter (1985) defines noise as "an audible acoustic energy that adversely affects the physiological or psychological wellbeing of people". The general meaning of 'NOISE' is an over loud or disturbing sound, which breaks the calmness of the atmosphere (Shahid and Bashir, 2013). When the level increases to an irritable level, it can be considered as "noise pollution" in the atmosphere (Philimoni, et al., 2011; Stanchina and Hijlem, 2005; Crmiel, et al., 2004). At present the environment has reached suchlike a position that it is hard to overlook sound pollution problem. Some places where people are exposed to a lot of sound pollution problems are industries, hospitals, roads, educational institutions, recreational areas and so on. By and large, lack of urban planning increases the exposure to unwanted sounds. This is why understanding noise pollution is necessary to curb it in time.

It is reported that the hearing ability of the inhabitants of the City has reduced during the last ten years (Ahmed, 1998). About five to seven percent of the patients admitted to the Bangabandhu Seikh Mujibur Rahman Medical University, Dhaka are suffering from permanent deafness due to noise pollution (Ahmed, 1998). Many studies have revealed that

extended exposure to noise pollution may cause auditory and non-auditory disorders, such as temporary or permanent hearing loss, sleep disruption, vertigo, agitation, weariness, hypertension, gastrointestinal system problems including gastric and duodenal ulcer, cardiac arrhythmia, nervous, myocardial infarction and ischemic heart diseases and psychic disorders and so on (Bond and Michael, 1994; Pathak, et al., 2008; Belojevic, et al., 2008; Babisch, 2000, 2006; Babisch, et al., 2005; Lundberg, 1999; Griefahn, 1990; Clark and Stansfeld, 2007).

The patient in hospitals receives far more bad impact by noise as it slower the healing process. Nightingale (1860) acknowledged noise as a health risk when she wrote "Unnecessary noise is the most cruel abuse of care which can be inflicted on either the sick or the well". According to the study of Researchers from the University of Chicago's Pritzker School of Medicine, 42% of patients reported being woken up by noise and many reported sleeping significantly less than normal while in the hospital. Patients exposed to the loudest average nighttime noises slept an average of 76 minutes less than patients exposed to the quietest noises. Some of world renowned organizations which have been working on noise level of hospitals for a long time are WHO, American National Standards Institute (ANSI) and United States Environmental Protection Agency (US EPA). They have fixed certain standard which a hospital should not exceed. The WHO's standard is 40 dB(A) whereas the ANSI's standard is 25-43 dB(A) depending on type of room again the US EPA's standard is 45 dB(A). But it is a matter of fact that almost all the hospitals in the world specially that of the Indian subcontinent fail to maintained those standard level.

Rajshahi Medical College Hospital (RMCH) is the only tertiary level hospital in this area, situated in the heart of Rajshahi city. The hospital receives a large number of patients from areas including whole Rajshahi division and the northern part of Khulna Division. This institute started its journey in 1958 with only 550 beds but now is able to accommodate around 1700 patients on a daily basis. Nowadays owing to population growth the numbers of patients are also increasing which creates a heavy pressure on this hospital. As a consequence, like other unmanageable situations, crowd, screaming, shouting are increasing day by day that hampers proper treatment environment in the hospitals. Therefore, the aim of this study is to ascertain the present condition of noise level and its causes in RMCH and to alert the hospital authority to take essential steps as well as people in general to be careful which will help to create a proper environment for the patient.

2. METHODOLOGY

2.1 Site Selection

The indoor noise level measurement was done in different wards of RMCH to ascertain the scenario of noise pollution. The wards were selected in such a way that all important wards were accounted for in measuring sensitivity, type of treatment, types of patients, number of patients, age of patients, surroundings, etc. So, the selected 11 wards were the Children, Medicine, Nephrology, Cardiology, Neurosurgery, Orthopedic, Neuromedicine, Surgery, Gynecology, Burn, and Post-operative wards. Furthermore, the ICU's noise level was determined as it is the most sensitive zone. Moreover, Noise of the frontal road was also measured to compare the indoor and outdoor noise level.

2.2 Operational Procedure

A portable digital sound level meter was used to measure the sound level at maximum and minimum levels. The sound pressure is detected in decibels (dB) in this instrument with expansive measuring limit from 30 dB(A) to 130 dB(A) having exactitude level of ±1.5dB. The measurement was performed at the middle of each ward at a 30 minuets interval from 8:00 am to 8:00 pm during two working days and one holiday. To measure the sound level,

holding the digital sound level meter in hand 'ON' button of it was pressed and it started. The maximum sound level was locked by pressing 'MAX' button which would be replaced when the higher value appeared. Within the time span the minimum value was also recorded and that time the sound level meter was not locked.

The overall situation of the wards was observed and perceptions of patients and doctors were noted. The noise level of nearby road was also measured during those periods. The collected data was analyzed for average of maximum and minimum noise level with their standard deviations.

3. RESULTS AND DISCUSSION

The average values of maximum and minimum noise level in decibel (dB) for three days from 8:00 am to 8:00 pm were determined for 12 wards of Rajshahi Medical College and Hospital. The average of average maximum noise of different wards varies from 71.68 dB to 75.41 dB. The results are graphically represented in Figure 1 and 2:

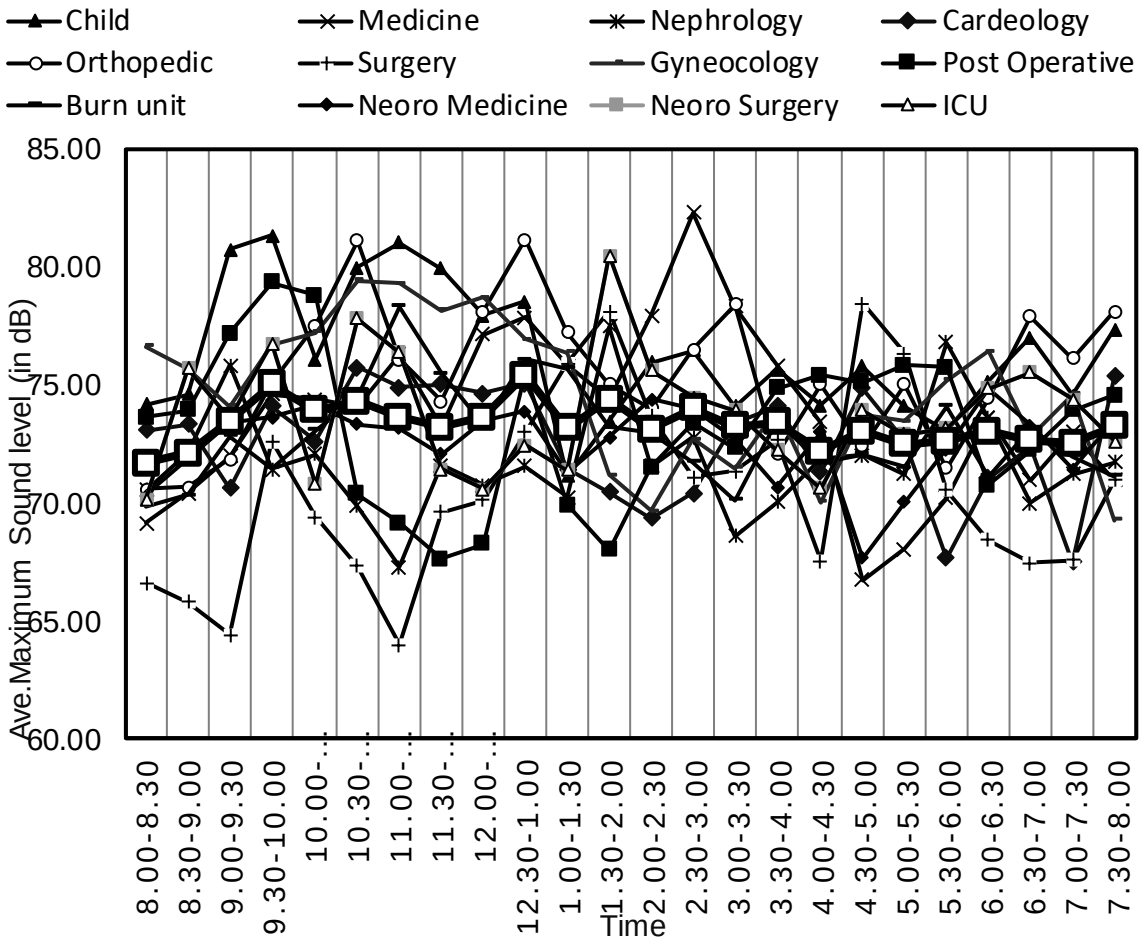

Figure 1: Variation of average maximum sound levels in different wards of RMCH

Child Care Unit (Ward No. 24) was full of child patients of different ages. Hence, the sounds of children crying and screaming resulted in a relatively high noise level at this ward at most of the times. Figure 1 shows that the maximum noise level in this ward is 81.3 dB whereas the minimum is 60.4 dB (Figure 2). The maximum noise level is usually seen at 9.30 a.m.to 10.30 a.m. in the morning.

In Medicine ward (Ward No. 17), the patients were generally quiet but the large gathering of visitors produced significant noise pollution. The following figure (figure 2) shows that the ward has a maximum noise level of 82.3 dB between 2.30 p.m. to 3.00 p.m. and its minimum noise level is about 60.3 dB.

Almost all the beds in Nephrology ward (Ward No. 21) were full of patients. The maximum and minimum noise level was 77.5 dB and 62.4 dB respectively in this ward. The maximum noise was found to be between 1.30 p.m. to 2.00 p.m.

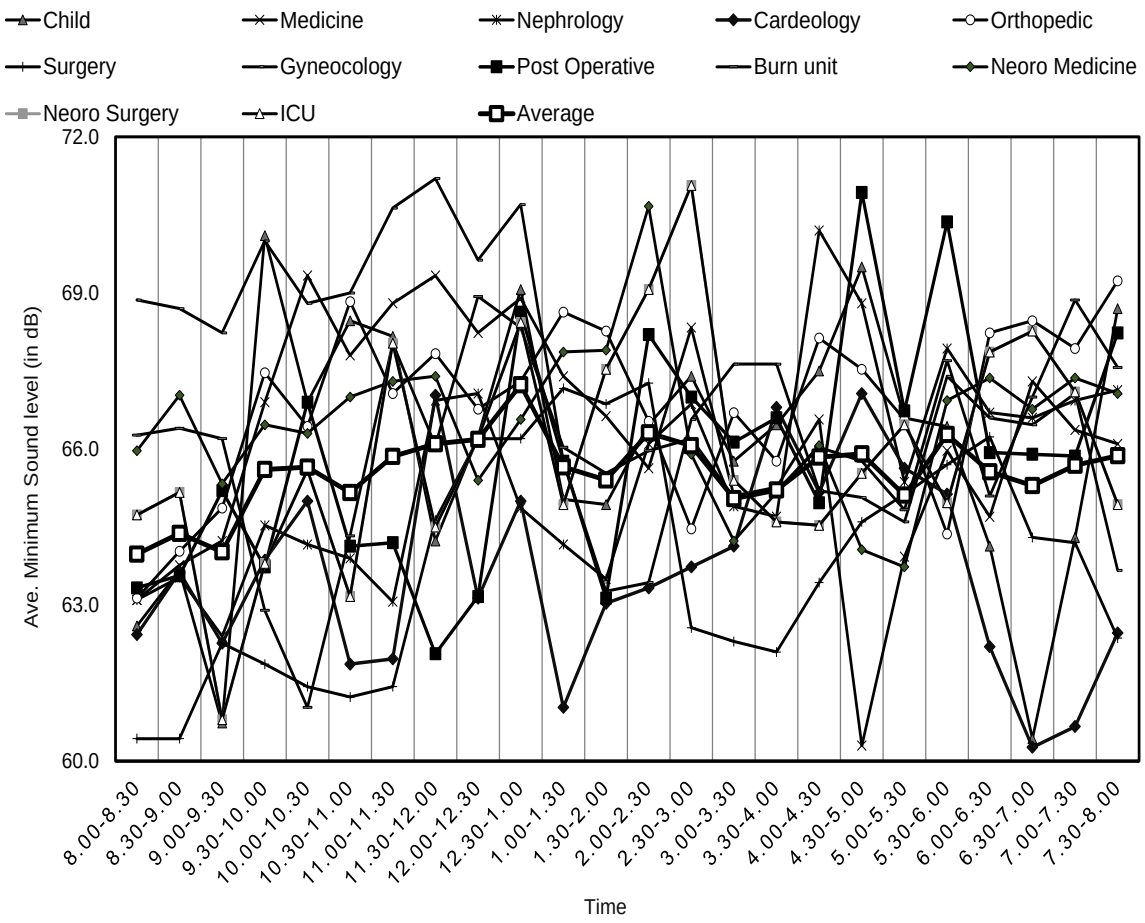

Figure 2: Variation of average minimum sound levels in different wards of RMCH

Since the Cardiology ward (Ward No. 7) serves patients of heart disorders, it is quite a sensitive unit. Despite that, the average maximum noise level was measured to be of 79.3 dB (in the morning at 10.00 to 10.30 a.m.). Furthermore, the minimum was 62.1 dB.

The Orthopedic ward (Ward No. 1) serves for the patients having bone fractures and related injuries face significant sound levels during doctor's visiting hours. From figure it is observed that the maximum noise level in this ward is 81.2 dB, occurring between 10.30 to11.00 a.m. in the morning, the average minimum noise level being 63.1 dB.

In Surgery ward (Ward No. 6), many patients were howling and screaming due to surgical pain. The average maximum noise level in this ward is found to be of 78.4 dB and the

average minimum noise level is 60.4 dB. The maximum noise level was at the afternoon between 4.30 to 5.00 p.m.

In Gynecology ward (Ward No. 22), the average maximum noise level is measured to be of 79.4 dB during the morning (11.00 to 11.30 a.m.) whereas the minimum noise level was 63.3 dB.

Mourning of visitors and screaming of patients due to pain after operation were common observations in Post-operative rooms. The average maximum noise level at this ward was recorded at 75.7 dB at evening between 7.30-8.00 p.m. and the minimum noise level was 60.2 dB.

The maximum and minimum noise level in the Burn Unit's (Ward No. 29) is 78.3 dB and 61.0 dB respectively, where the maximum noise level was observed during 11:00 to 11:30 a.m. interval.

In the Neuromedicine ward (Ward No. 7), gathering of people (including patients, visitors) was high due to its large room size. Figures show that the maximum noise level was 74.8 dB (between 9.00 to 9.30 a.m. in the morning), whereas the minimum was 63.7 dB.

The Neurosurgery ward had many patients who were admitted due to accidents and many of their visitors were lamenting profusely. So the noise level can be significantly high in this ward. The Figure 1 and 2 represent that the average maximum noise level in this ward is observed to be of 80.5 dB at the noon during 1.30 to 2.00 p.m. The minimum noise level in this ward does not go below 60.8 dB.

ICU is a special department of this hospital with 10 beds which provides intensive treatment to patients in critical health conditions. All the beds were attached with several instruments which were creating alarm sounds quite frequently. In figure it is observed that the maximum and minimum noise level in this unit is 74.2 dB and 61.6 dB respectively.

The World Health Organization recommends that average patient room noise levels remain around 30 decibels. According to Medscape Medical News, the recommended maximum noise level is 40 decibels. However, from Figure 1 and 2, it is clear that the noise levels in every ward both for maximum and minimum noise levels are far above the standard limit. For ICU, the WHO's guideline is 30 dB for maximum noise level and any ICU should not cross this limit. But the ICU in this hospital fails to maintain this standard for both maximum and minimum noise levels.

It was observed that the noise was mainly due to the admission of patients beyond capacity, conversations and gossiping between personnel, particularly attendants, care givers, staffs and nurses. Furthermore, screaming of patients (especially the children), doctor's discussions with the patients, moving of trolleys containing wastes, medicines and foods, instrumental alarms, lamenting of the relatives in the event of a patient's death, mobile phones, crowding of people during meal time, classes for interns within the wards, old electric devices such as old fans contribute to the high level of sounds in RMCH.

After consulting with the doctors at the wards, it was known that the noise level has been imparting several negative impacts on the patients' health. It impedes their healing process, seesaws heart rate and blood pressure; causes sleep disturbance as well as prolonging their stay time in the hospital. Besides the doctors, nurses and all other staffs are physically and psychologically disturbed and exhausted due to this extreme level of noise.

On the other hand, noise levels at the frontal road of RMCH was also measures in same way and the variations of noise levels in maximum and minimum are presented in Figure 3. From

the figure it is observed that noise level is lower at the morning time and it is gradually increasing as day grows up. At 10:30 am the noise level exceeds 90 dB and reached to the highest at above 100 dB during 3:00 to 3:30 pm and similar observation was also mentioned by Bari, et al., (2017).

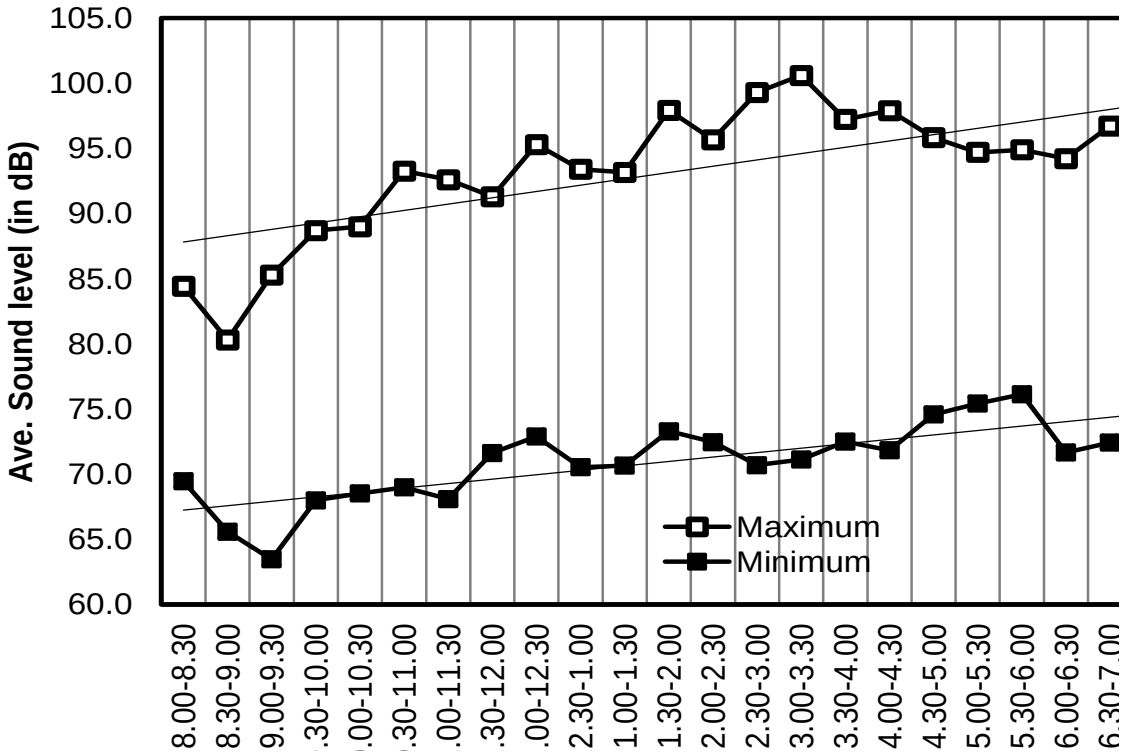

Figure 3: Variation of average maximum and minimum sound at frontal road of RMCH

Furthermore, the average minimum noise level of the nearby road during the same periods was observed that the trend of increasing of noise level is following almost same nature. The average minimum noise level is varying between 65 to 75 dB at the nearby road. However, sound from road side was not found inside the hospital wads at any time. Although, the maximum allowable noise level around the hospital is 60 dB while the average minimum noise level is also exceeds that limit.

This pollution can mitigate by two ways: one is by modifying the infrastructure by maintaining proper building code and the other is by adopting proper management by employing a standard code of conduct for doctors, caregivers, patients and visitors. Some of these changes could be expanding the hospital to reduce gathering of people, creating awareness among the visitors, ensuring attendants stay calm, replacing the alarm system of the instruments by visual light or permitting alarms only for critical readings, replacing the old electric devices (such as fans) with new ones, creating a habit of keeping mobile phones in silent modes within hospital grounds, training the nurses and other staffs perform their duties and keep away from gossiping and vain talk, increasing the number of beds to stop quarrelling of the patient's attendants for bed, and create a more systematic method of distributing food. Moreover, the authority and administrative department of the hospital should introduce some rules to reduce noise level and provide proper monitoring about maintaining the rules as well as punishment for breaking them.

4. CONCLUSIONS

From the above discussion, it can be inferred that the whole hospital environment is exposed to an intolerable amount of sound pollution that does not originate from the nearby road's noise. The adverse effect of this phenomenon on the patients, doctors, nurses and other people visiting to the hospital is undeniable. It is high time that the hospital's authority of RMCH should consider the excessive noise level as a serious health hazard and should take necessary steps to reduce it.

ACKNOWLEDGEMENTS

The authors thank to the Dr. Mostofa Kamal, ICU consultant, RMCH for giving permission and necessary help to take the reading of ICU. The authors also thank all the doctors, nurses, staffs and patients of RMCH for their co-operation.

REFERENCES

Ahmed, M.F. (1998). A Study on Noise Pollution in Dhaka City. Department of Environment, Bangladesh.

Babisch W., (2006). Transportation noise and cardiovascular risk: updated review and synthesis of epidemiological studies indicate that the evidence has increased. Noise & Health. Vol. No. 8(30), pp 1-29.

Babisch W., Beule B., Schust M., Kersten N., Ising H., (2005). Traffic noise and risk of myocardial infarction. Epidemiology. Vol. No. 16, pp 33-40.

Babisch, W., (2000). Traffic Noise and Cardiovascular Disease: Epidemiological Review and Synthesis. Noise and Health. Vol. No. 2(8), pp 9-32.

Bari, M.N., Biswas A. and Baki A.A. (2017). Determination of Noise Level of Different Places of Rajshahi City. International Conference on Planning, Architecture & Civil Engineering (ICPACE 2017), 09 – 11 February, 2017, Faculty of Civil Engineering, RUET, Rajshahi.

Belojevic G.A., Jakovljevic B.D., Stojanov V.J., Slepcevic V.Z. and Paunovic, K.Z., (2008). Night time road-traffic noise and arterial hypertension in an urban population. Hypertension Research. Vol. No. 31(4), pp 775-781.

Bond and Michael, 1994. Plagued by noise. New Scientist. pp 14-15.

Clark C. and Stansfeld, A.S. (2007). The Effect of Transportation Noise on Health and Cognitive Development: A Review of Recent Evidence. International Journal of Comparative Psynology. Vol. No. 20(1), pp 145-158.

Crmiel C.A., Klarr D.M., Gasser L.M., Oliphant and Neveau A.J., (2004). Noise control: a nursing team approach to sleep promotion. J. Nurs. Vol. No. 104(2), pp 40-48.

Crmiel C.A., Klarr D.M., Gasser L.M., Oliphant and Neveau A.J., (2004). Noise control: a nursing team approach to sleep promotion. J. Nurs. Vol. No. 104(2), pp 40-48.

Griefahn B., (1990). Research on Noise and Sleep and Public Health Problem. Swedish Council for Building Research. pp 5.

Kryter K.D. "The effects of noise on man. New York: Academic Press; 1985. Retrived from https://www.conserve-energy-future.com/causes-and-effects-of-noise-pollution.php

Lundberg U., (1999). Coping with Stress: Neuroendocrine Reactions.

Nightingale F. (1860). Notes On nursing: what it is, and what it is not. New York: Appleton; 1860. Retrived from https://www.advisory.com/Daily-Briefing/2012/01/11/Hospital-noise

Pathak, Tripathi and Mishra V.K., (2008). Evaluation of Traffic Noise Pollution and Attitudes of Exposed Individuals in Working Place. Atmospheric Environment. Vol. No. 42 (16), pp 3892-3898.

Philimoni KM,, Stelyus L and Mkoma Moshi AA, (2011). Noise pollution on wards in Bunda district hospital in Lake Victoria zone, Tanzania. Int. J. Environ. Sci. Vol. No. 1(5), pp 1007-1015.

Shahid M.A.K. and Bashir,H. (2013). Psychological and physiological effects of noise pollution on the residents of major cities of Punjab, Pakistan. Peak Journal of Physical and Environmental Science Research Vol. No. 1(4), pp 41-50.

Stanchina M.L. and Abu-hijlem, (2005). The influence of white noise on sleep in subjects exposed to ICU noise.J. Vol. No. Vol. No. 6(5), pp 423-428.