Comparative Analysis of Noise Pollution at Educational Institutions in Dhaka City

Ahmad Kamruzzaman Majumder[1, 2, *] Mohammad Rakibul Islam[1]

[1]*Department of Environmental Science, Stamford University Bangladesh*
[2]*Center for Atmospheric Pollution Studies (CAPS)*
Corresponding Author
ORCID
https://orcid.org/0000-0002-6955-607X (Ahmad Kamruzzaman Majumder)

Abstract—The aim of this study is to measure the noise pollution level in the educational institutions of Dhaka City. 20 educational institutions were chosen from various areas of the Dhaka Metropolitan City. From January 1, 2021, to April 30, 2021, noise levels from the educational institutions were measured using a sound level meter (REED SD-4023). Every sampling site had a large number of samples taken. Three times a day, the noise level was measured at each site. The overall mean noise level and Leq in the researched educational institutions were found to be 74 dBA and 79.02 dBA, respectively. The hierarchy in the mentioned educational institutions of Dhaka City based on mean noise level was Rajuk Uttara Model College > Bhuiyan Ideal School > Talimul Qu'ran School and Madrasha > Kallyanpur Girl's School and College > Green University of Bangladesh > Al Madinah Cadet Madrasa > BAF Shaheen College, Tejgaon > Tanjimul Ummah Alim Madrasha > Sir Salimullah Medical College > Bhashantek Govt. Secondary School > Jannatul Ma'owa Madrasha > Khilkhet Technical College > South Breeze School > Full Bright English Medium School > Mirpur College > European University of Bangladesh > Prime University > World University of Bangladesh > East-West International School > Uttara University. The three educational institutions with the highest noise pollution levels were Rajuk Uttara Model College (100.76 dBA), Bhuiyan Ideal School (89.39 dBA), and Talimul Qu'ran School and Madrasha (88.52 dBA), while the three lowest noise-polluted educational institutions were Uttara University (68.93 dBA), European University of Bangladesh (70.22 dBA), and Khilkhet Technical College (72.39 dBA) in terms of Leq. The noise levels in all of the locations we looked into for our study were therefore higher than the national standard.

Index Terms—Noise Pollution, Educational Institutions, Noise Standard, Cluster, Dispersion, Dhaka City.

I. INTRODUCTION

Educational institutions, particularly schools and colleges, are essential for a child's early development. All levels of education, including primary, elementary, secondary, and higher, must be completed by pupils to achieve their educational goals. Schools and colleges in Dhaka City play a significant role by offering education at various levels, particularly at the HSC level. There are currently 432 private secondary schools in the city, with a total enrollment of 281,854 pupils, as reported by the Bangladesh Bureau of Educational Information and Statistics. Essentially, these schools are situated on the roadside. When students make too much noise, it makes teachers angry and makes them yell. It also leads to a vicious cycle of increasing volume as a means for young people to be heard. Teachers' and students' hearing may be negatively impacted by these impacts over time. Moreover, headaches, fatigue, tension, impaired hearing, reduced work productivity, and sleep disturbances are among the various potential side effects due to noise pollution [1-3].

Prolonged exposure to elevated urban noise levels can impair auditory function and cognitive abilities, particularly in young children. Anxious students exhibit a higher propensity for smoking, procrastination, excessive alcohol consumption, and drug use, among other detrimental behaviors [4]. Automobiles and various modes of transportation are the primary contributors to noise pollution in urban areas [5]. Elevated noise levels adversely impact both the economy and the environment. The decline in biodiversity will impede individuals' ability to lead fulfilling lives [6].

Police personnel stationed at busy intersections are more prone to health issues due to elevated levels of noise and air pollution [7–13]. Traffic cops may occasionally experience cognitive and auditory impairments [14–17]. The government has attempted to mitigate noise pollution; yet, it remains a significant issue in the congested urban environment. Numerous traffic officers don masks throughout their duties to prevent coughing from contaminating the air, which may exacerbate upper respiratory conditions. The impact of noise on hearing is frequently underestimated, obscuring its significance. The World Health Organization (WHO) identifies occupational noise as a significant global health issue, attributed to 25 distinct risk factors [18].

Various occurrences in the workplace might lead to partial or full hearing loss in one or both ears [19]. Hearing loss can occur mostly from exposure to loud noises and physical injury. Individuals around are concerned about the increasing noise levels in workplaces. Approximately 30 million Americans are employed in environments characterized by high noise levels [20]. The World Health Organization (WHO) reports that excessive noise in the workplace impacts four to five million German employees, constituting 12 to 15% of the whole workforce [21].

All activities generate noise; however, certain activities, such as commercial aviation, transportation of goods, and impact operations, are notably louder than others. Noise-induced hearing loss (NIHL) is increasingly prevalent in sectors such as mining, manufacturing, transportation, agriculture, and the military. An increasing number of individuals in industrialized nations are acknowledging existing issues and seeking solutions, which is commendable. In numerous developed nations, the mean noise level significantly exceeds safe thresholds for workers. Nevertheless, discussions frequently neglect the challenges faced by emerging nations [22–25].

Noise can adversely affect both auditory and non-auditory systems. Extensive study has been conducted on the impact of intense, high-frequency noise on nearby residents [26-30]. Nonetheless, no investigation has been conducted to determine if traffic noise affects the aural abilities of traffic officers [13]. The elevated noise levels in Educational Institutions District Town hinder police personnel's ability to hear and observe effectively. Individuals who fail to utilize their hearing aids as directed may be exposing themselves to significant risk. It is imperative for law enforcement to prioritize the identification of health threats. Many people ignore noise because they think it doesn't matter in the environment. Medical professionals assert that prolonged exposure to noise levels of 80 dBA or more might adversely affect auditory function, potentially resulting in temporary or permanent damage.

Bangladesh may underestimate the significance of noisy venues. We must examine the alternative options that are available. If the government neglects public safety, noise issues may rapidly escalate [31-37]. This study aimed to analyze the level of noise pollution in educational institutions by measuring noise levels at 20 educational institutions in Dhaka City.

II. METHODOLOGY

2.1. Study Area

20 Educational Institutions of Dhaka City named South Breeze School, Rajuk Uttara Model College, World University of Bangladesh, Uttara University, Tanjimul Ummah Alim Madrasha, Talimul Qu'ran School and Madrasha, Bhashantek Govt. Secondary School, Sir Salimullah Medical College, Mirpur College, Prime University, European University of Bangladesh, Kallyanpur Girl's School and College, East-West International School, Full Bright English Medium School, Al Madinah Cadet Madrasa, Jannatul Ma'owa Madrasha, BAF Shaheen College, Tejgaon, Green University of Bangladesh, Khilkhet Technical College, and Bhuiyan Ideal School were selected as the focal point of the study due to increasing urbanization and a recent substantial rise in the number of automobiles and enterprises. The ambient noise levels in Dhaka City generally exceed international guidelines by two to three times. This situation may harm both the environment and human health. The primary focus of the research is on selected educational institutions in Dhaka City that experience higher than standard noise levels.

2.2. Data Collection

Using a sound level meter (REED SD-4023), the ambient sound pressure levels in the designated

educational institutions in Dhaka City were monitored between January 1, 2021, and April 30, 2021. Additionally, customers can select a sample rate ranging from 1 to 3,600 seconds with the SD series of sound level meters. Triple-range readings are also provided by the meters. Without the need for software, the user may rapidly create an Excel file with raw data and choose the sample rate they want using an SD card (up to 16 GB). For ongoing, long-term monitoring, consumers can purchase an AC adapter and tripod as add-ons. They can also use PC software to track measurements in real time. We conducted the survey during the week. The examination focused on the city's main intersections. We used A-weighting to measure the acoustic pressure in the highway area.

2.3. Measuring Procedure and Analysis

The data recording function records the highest and lowest values. Press (Figure 1) the REC button once to initiate the Data Record feature; a "REC" symbol will appear. The screen will display the "REC" indication. Press the REC button once to begin. The maximum number will be shown with an indicator that says "REC. MAX." A "REC." symbol, which denotes the continuous memory process, will appear on the screen after users push the Hold Button to remove the maximum value. Second, when someone presses the REC button once again, the user will see the minimal number and the "REC. MIN." sign. The minimum value can be removed by simply pushing the Hold Button once; the memory function will then continue to run continuously, and the screen will merely display the "REC." signal. Third, to end the memory recording feature, press and hold the REC button for two seconds. It will return to the screen's current reading. The information was gathered while standing more than 1.5 meters above the ground on the road. We took care to disregard any and all noise obstructions when measuring the real sound level. Data from each station was collected for a total of five minutes, with a one-second sampling duration. A microSD card was used to store the recorded data. Data analysis was conducted using IBM SPSS 20 and Microsoft Excel 2010.

Figure 1: Sound Level Meter (REED SD-4023).

III. RESULT AND DISCUSSION

The overall mean noise level and Leq in the Educational Institutions of Dhaka City that were studied were 74 dBA and 79.02 dBA, respectively.
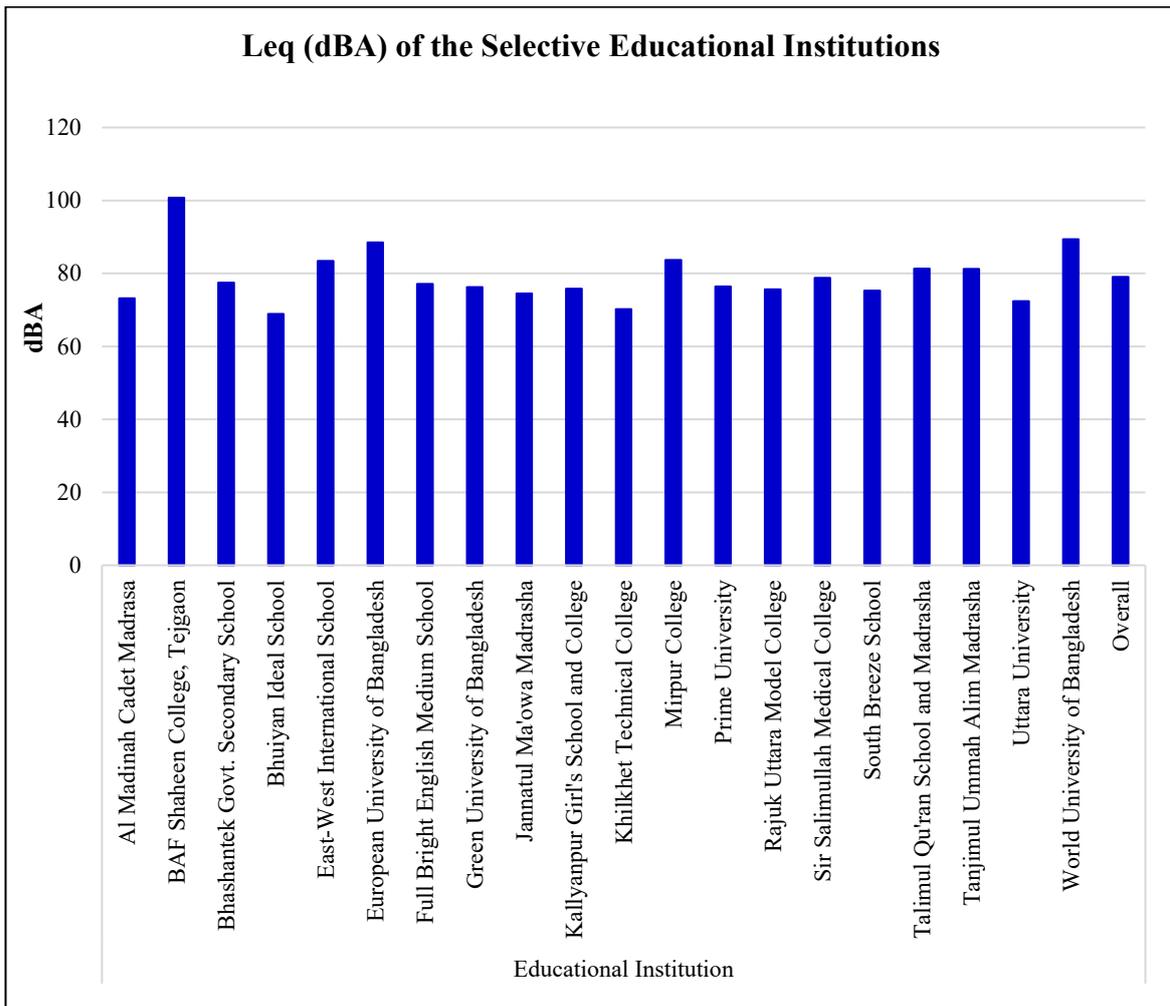
Figure 2: Analysis of Leq (dBA) in Selective Educational Institutions of Dhaka City.

Figure 2 demonstrates the analysis of Leq (dBA) across 20 selected educational institutions in Dhaka City. The Leq value was found to be higher in Rajuk Uttara Model College (100.76 dBA). Furthermore, the Bhuiyan Ideal School (89.39 dBA) was recorded close to the highest Leq value of the mentioned educational institutions in Dhaka City. Additionally, Talimul Qu'ran School and Madrasha had the Leq value of 88.52 dBA, nearing the second highest value recorded. Conversely, the lowest Leq value was discovered in Uttara University (68.93 dBA). Besides, the Leq of the European University of Bangladesh (70.22 dBA) was near to the maximum Leq value. Moreover, Khilkhet Technical College (72.39 dBA) recorded the closest second-highest Leq value of the selected educational institutions of Dhaka City. As a result, we can determine the three educational institutions with the highest noise pollution levels were Rajuk Uttara Model College (100.76 dBA), Bhuiyan Ideal School (89.39 dBA), and Talimul Qu'ran School and Madrasha (88.52 dBA), while the three lowest noise-polluted educational institutions were Uttara University (68.93 dBA), European University of Bangladesh (70.22 dBA), and Khilkhet Technical College (72.39 dBA) in terms of Leq.
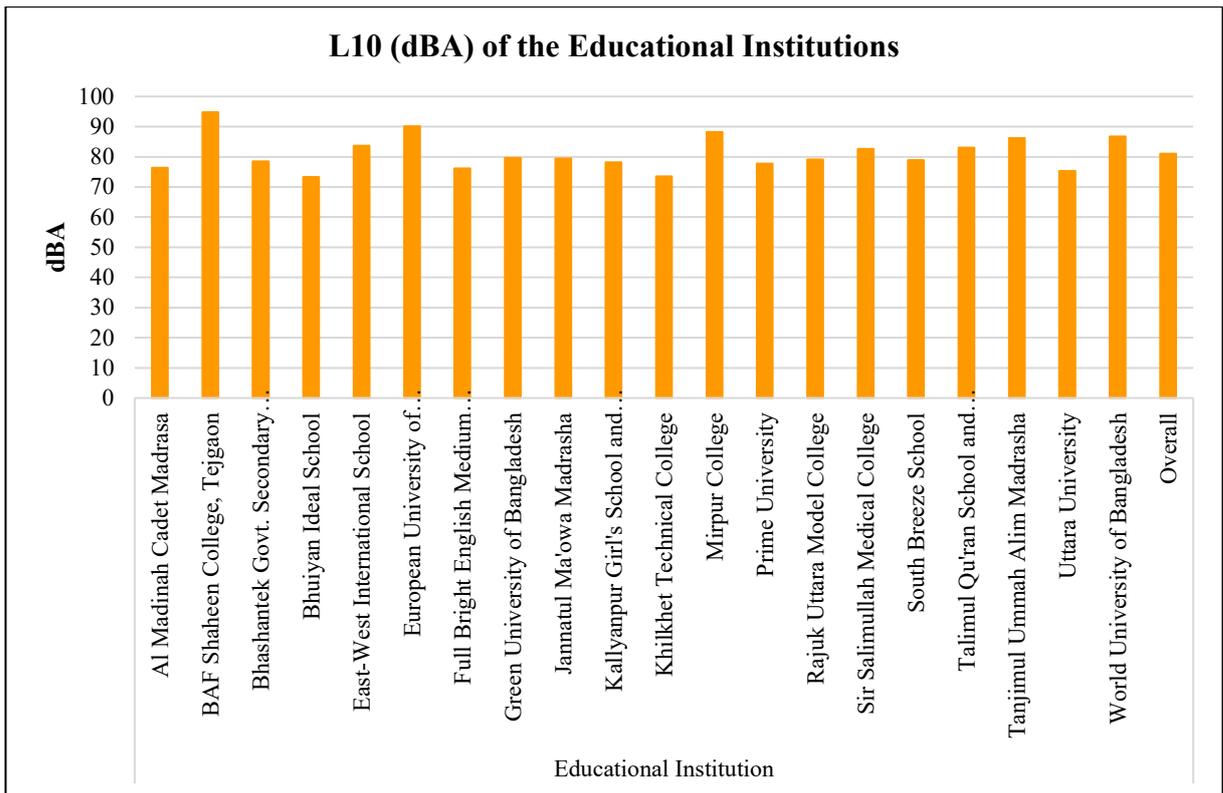
Figure 3: Analysis of L10 (dBA) in Selective Educational Institutions of Dhaka City.

Figure 3 reveals the investigation of L10 (dBA) in 20 selected educational institutions in Dhaka City. The L10 was found to be higher in BAF Shaheen College, Tejgaon (94.73 dBA), and lower in Bhuiyan Ideal School (73.24 dBA). Additionally, the L10 values of European University of Bangladesh (90.14 dBA) and Mirpur College (88.20 dBA) were close to the maximum value, whereas the L10 of Khilkhet Technical College (73.50 dBA) and Uttara University (75.31 dBA) were quite similar to the minimum L10. The overall value of L10 in the determined educational institutions of Dhaka City was found to be 81.06 dBA.
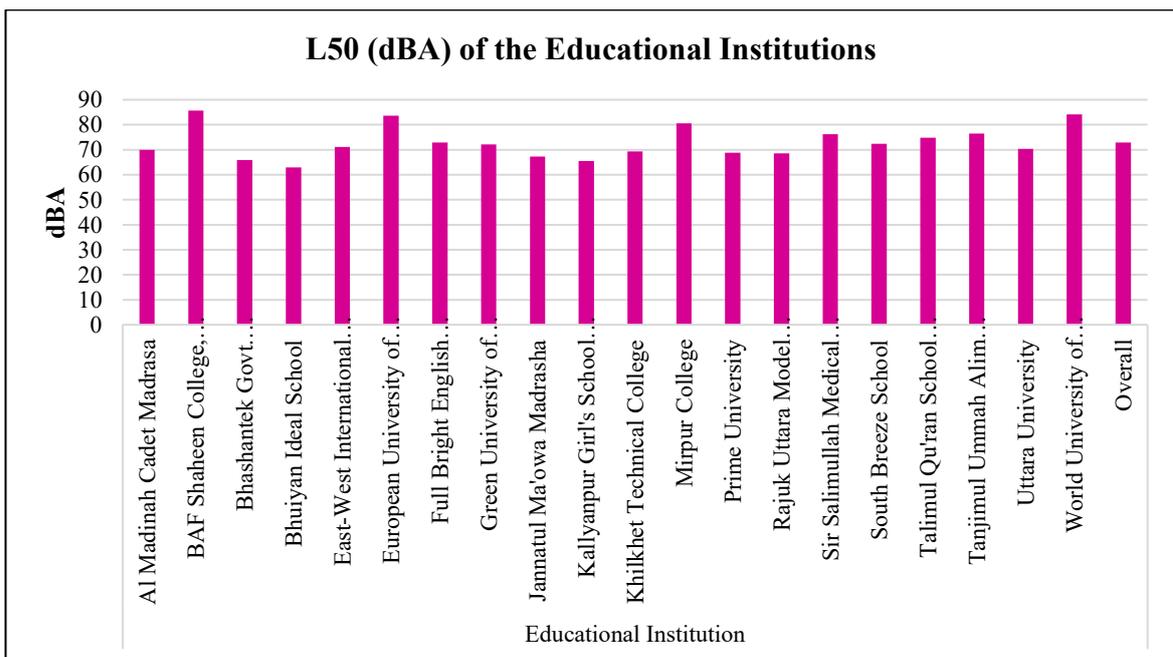

Figure 4: Analysis of L50 (dBA) in Selective Educational Institutions of Dhaka City.

Figure 4 explores the outcomes of L50 (dBA) in 20 selected educational institutions in Dhaka City. The maximum L50 was found in BAF Shaheen College, Tejgaon (85.70 dBA), and the minimum L50 was discovered in Bhuiyan Ideal School (63 dBA). Furthermore, the L50 values of World University of Bangladesh (84.10 dBA) and European University of Bangladesh (83.60 dBA) were adjacent to the highest L50 value, while the L50 of Kallyanpur Girl's School and College (65.50 dBA) and Bhashantek Govt. Secondary School (65.90 dBA) were almost similar to the lowest L50 value. The overall value of L50 in the explored educational institutions of Dhaka City was found to be 72.93 dBA.
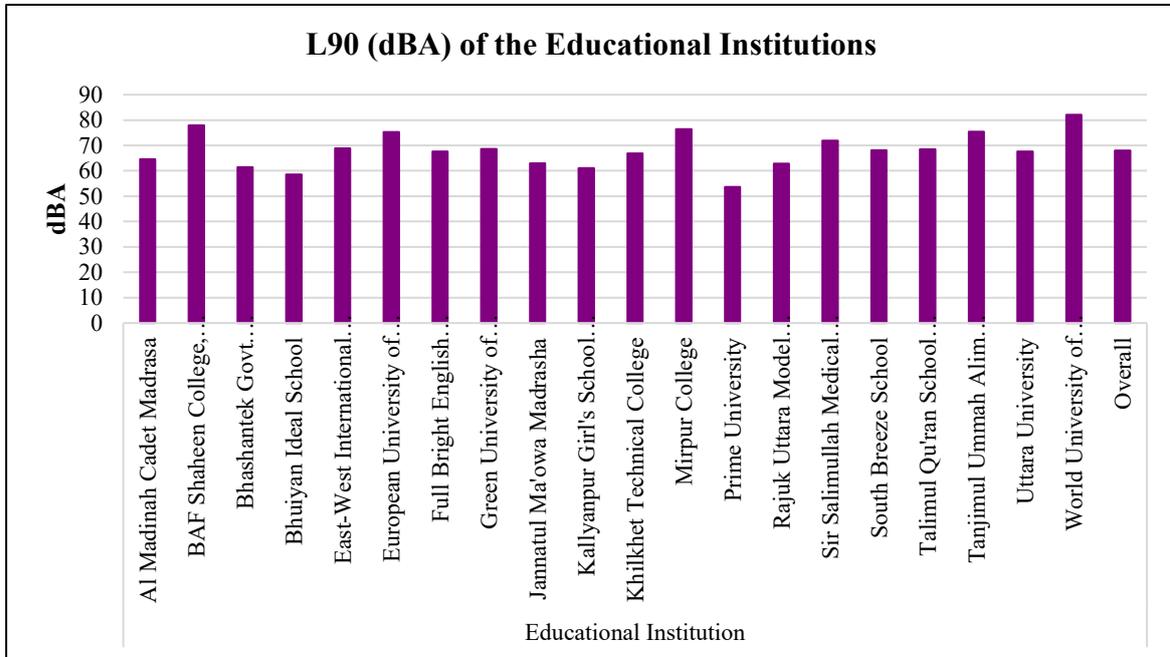

Figure 5: Analysis of L90 (dBA) in Selective Educational Institutions of Dhaka City.

Figure 5 denotes the exploration of L90 (dBA) in 20 selected educational institutions in Dhaka City. The overall value of L90 in the examined educational institutions of Dhaka City was found to be 68.01 dBA. The highest L90 was recorded at the World University of Bangladesh (82.03 dBA); however, the lowest L90 was found at Prime University (53.70 dBA). In addition, the L90 values of BAF Shaheen College, Tejgaon (77.94 dBA), and Mirpur College (76.40 dBA) were almost close to the uppermost L90 value, while the L90 of Bhuiyan Ideal School (58.50 dBA) and Kallyanpur Girl's School and College (61.08 dBA) were nearly close to the lowermost L90 value.
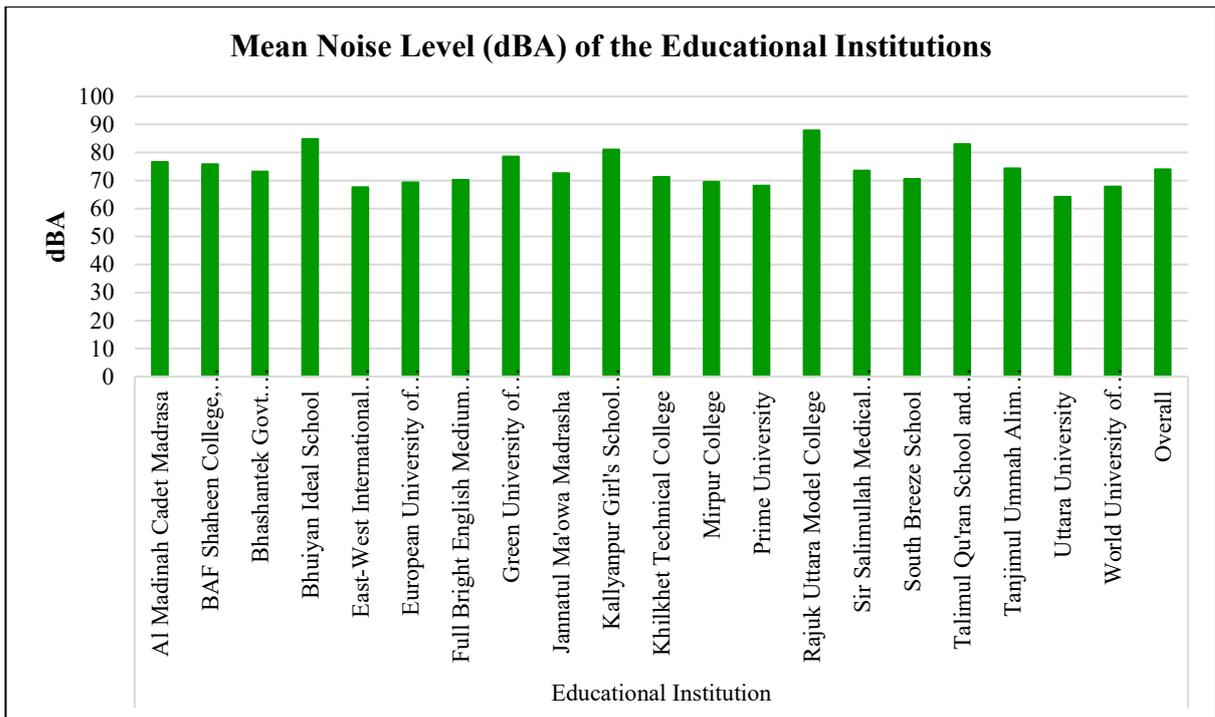
Figure 6: Mean Noise Level (dBA) in Selective Educational Institutions of Dhaka City.

Figure 6 illustrates the mean noise levels (dBA) at 20 educational institutions in Dhaka City. The Rajuk Uttara Model College had the highest mean noise level of 87.86 dBA, while Uttara University had the lowest mean noise level of 64.23 dBA. The order of the analyzed educational institutions of Dhaka City based on mean noise level was Rajuk Uttara Model College > Bhuiyan Ideal School > Talimul Qu'ran School and Madrasha > Kallyanpur Girl's School and College > Green University of Bangladesh > Al Madinah Cadet Madrasa > BAF Shaheen College, Tejgaon > Tanjimul Ummah Alim Madrasha > Sir Salimullah Medical College > Bhashantek Govt. Secondary School > Jannatul Ma'owa Madrasha > Khilkhet Technical College > South Breeze School > Full Bright English Medium School > Mirpur College > European University of Bangladesh > Prime University > World University of Bangladesh > East-West International School > Uttara University.

Table 1: Dispersion of Noise Quality in Selective Educational Institutions at Dhaka City

Institution Name	Leq	L10	L50	L90	Mean	Min	Max	SD	Range	Median
Al Madinah Cadet Madrasa	73.22	76.30	69.90	64.60	76.64	71.20	83.90	4.53	12.70	76.25
BAF Shaheen College, Tejgaon	100.76	94.73	85.70	77.94	75.77	67.70	91.20	6.62	23.50	74.85
Bhashantek Govt. Secondary School	77.50	78.52	65.90	61.45	73.20	66.10	86.80	4.98	20.70	72.90
Bhuiyan Ideal School	68.93	73.24	63.00	58.50	84.86	77.00	98.80	5.02	21.80	84.10
East-West International School	83.40	83.70	71.10	68.88	67.59	52.00	85.20	10.68	33.20	68.80
European University of Bangladesh	88.52	90.14	83.60	75.26	69.35	63.80	74.00	2.94	10.20	69.30
Full Bright English Medium School	77.14	76.16	72.90	67.56	70.23	61.60	85.30	6.68	23.70	68.50
Green University of Bangladesh	76.21	79.65	72.15	68.65	78.54	74.60	87.80	4.36	13.20	76.50
Jannatul Ma'owa Madrasha	74.52	79.40	67.30	62.94	72.63	59.10	81.50	5.41	22.40	72.40

Kallyanpur Girl's School and College	75.83	78.10	65.50	61.08	81.07	76.30	89.70	4.77	13.40	80.50
Khilkhet Technical College	70.22	73.50	69.30	66.90	71.20	65.80	76.20	3.39	10.40	70.35
Mirpur College	83.69	88.20	80.50	76.40	69.52	62.10	81.60	6.62	19.50	67.30
Prime University	76.40	77.70	68.80	53.70	68.13	55.70	85.50	7.69	29.80	65.50
Rajuk Uttara Model College	75.63	79.10	68.50	62.80	87.86	77.30	111.90	9.25	34.60	85.70
Sir Salimullah Medical College	78.78	82.55	76.25	71.88	73.53	67.50	83.40	4.74	15.90	72.15
South Breeze School	75.27	78.88	72.40	68.16	70.60	62.90	78.80	5.20	15.90	69.90
Talimul Qu'ran School and Madrasha	81.36	83.00	74.85	68.50	82.99	74.20	91.60	5.82	17.40	83.60
Tanjimul Ummah Alim Madrasha	81.24	86.24	76.50	75.40	74.29	66.40	93.70	7.44	27.30	71.10
Uttara University	72.39	75.31	70.35	67.59	64.23	57.20	76.90	6.04	19.70	63.00
World University of Bangladesh	89.39	86.78	84.10	82.03	67.82	58.30	87.90	8.07	29.60	65.90
Overall	79.02	81.06	72.93	68.01	74.00	65.84	86.59	6.01	20.75	72.93

Table 1 demonstrates the noise quality dispersion across 20 Dhaka City educational institutions. The overall Leq, L10, L50, L90, and mean noise levels were found to be 79.02 dBA, 81.06 dBA, 72.93 dBA, 68.01 dBA, and 74.00 dBA. Furthermore, the noise level range in the mentioned educational institutions was found to be 20.75 dBA. The maximum noise level was recorded in Rajuk Uttara Model College (111.90 dBA), and the minimum noise level was found in East-West International School (52 dBA). The Leq value was discovered to be higher in Rajuk Uttara Model College (100.76 dBA) and lower in Uttara University (68.93 dBA). The highest mean was found in the Rajuk Uttara Model College (87.86 dBA) and the lowest mean in the Uttara University (64.23 dBA). Moreover, the higher range was revealed in Rajuk Uttara Model College (34.60 dBA), and the lower range was noticed in European University of Bangladesh (10.20 dBA).
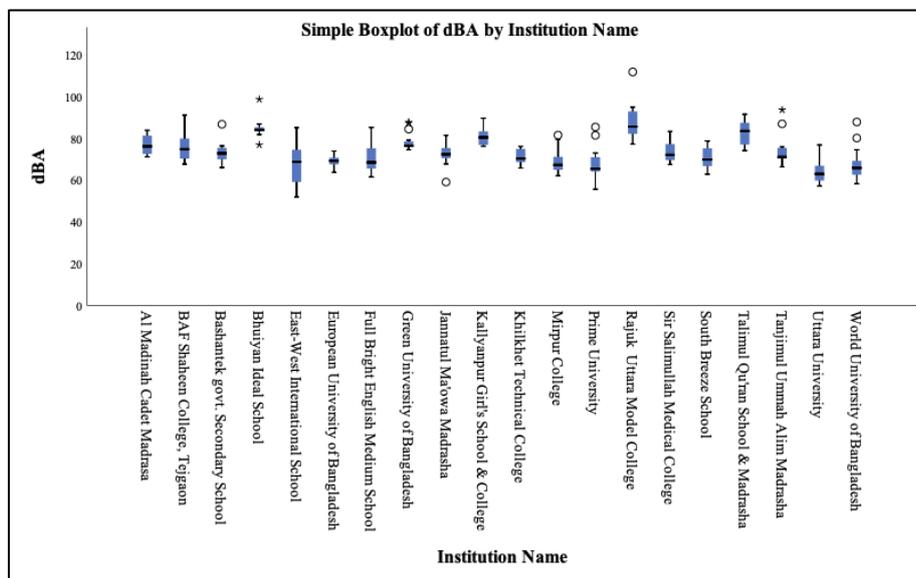

Figure 7: Whisker Box Plot for Mean Noise Pollution in Educational Institutions.

The whisker box plot (Figure 7) illustrates mean noise pollution in the 20 educational institutions of Dhaka City. A horizontal black line marks the median. The lower boundary of the box indicates the 25th percentile. The upper boundary of the box indicates the 75th percentile. The whisker represents the maximum (upper whisker) and minimum value (lower whisker). Points above the whiskers indicate outliers.
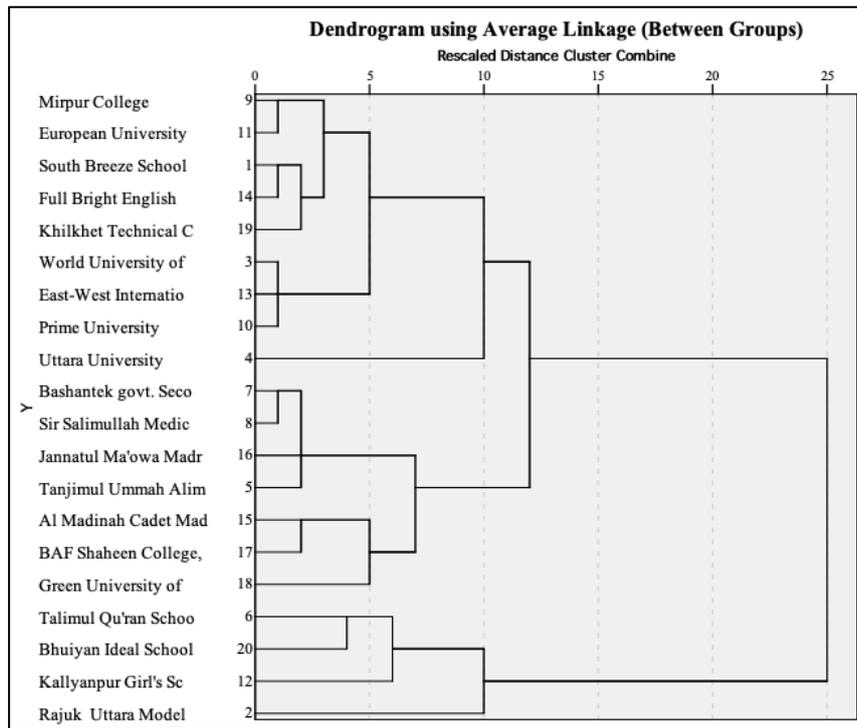
Figure 8: Cluster Analysis of Noise Pollution in the Selective Educational Institutions.

Figure 8 demonstrates the cluster analysis of noise pollution in the mentioned educational institutions of Dhaka City. The study revealed four clusters. The first cluster showed the European University of Bangladesh, Fulbright English Medium School, World University of Bangladesh, Prime University, and Sir Salimullah Medical College. The second cluster includes South Breeze School, Khilkhet Technical College, Bhashantek Govt. Secondary School, and Tanjimul Ummah Alim Madrasha, while the final cluster includes Mirpur College, Talimul Qu'ran School and Madrasha, and Bhuiyan Ideal School.

Table 3: Comply with Noise Standard [38]

School Name	Standard Value	Within Standard
South Breeze School	50	0%
Rajuk Uttara Model College		0%
World University of Bangladesh		0%
Uttara University		0%
Tanjimul Ummah Alim Madrasha		0%
Talimul Qu'ran School and Madrasha		0%
Bhashantek Govt. Secondary School		0%
Sir Salimullah Medical College		0%
Mirpur College		0%
Prime University		0%
European University of Bangladesh		0%
Kallyanpur Girl's School and College		0%
East-West International School		0%
Full Bright English Medium School		0%

Al Madinah Cadet Madrasa		0%
Jannatul Ma'owa Madrasha		0%
BAF Shaheen College, Tejgaon		0%
Green University of Bangladesh		0%
Khilkhet Technical College		0%
Bhuiyan Ideal School		0%
All Mean		**0%**

In the study, we took 20 educational institutions named South Breeze School, Rajuk Uttara Model College, World University of Bangladesh, Uttara University, Tanjimul Ummah Alim Madrasha, Talimul Qu'ran School and Madrasha, Bhashantek Govt. Secondary School, Sir Salimullah Medical College, Mirpur College, Prime University, European University of Bangladesh, Kallyanpur Girl's School and College, East-West International School, Full Bright English Medium School, Al Madinah Cadet Madrasa, Jannatul Ma'owa Madrasha, BAF Shaheen College, Tejgaon, Green University of Bangladesh, Khilkhet Technical College, and Bhuiyan Ideal School for determining the proportion rate with noise standard [38]. The analysis of 20 educational institutions revealed that none of them meet the established noise standards. Consequently, it can be concluded that the noise pollution levels in these institutions significantly exceed the acceptable limits.

Unless the education schools follow the noise standards, it can be very hazardous for students and teachers to discover a complete learning environment. Noise pollution makes it challenging to focus and learn, as it makes it harder to understand speech and remember things [39]. Long-term exposure to loud noises may slow down kids' language development and make both students and staff more frustrated, worn out, and concerned [40]. Doctors said that noisy venues can induce migraines, trouble sleeping, and hearing loss [41]. Teachers typically have vocal strain because they have to talk louder to be heard above background noise, which makes them less effective at teaching [42]. Basically, random noise pollution makes the academic environment worse, hurts the reputation of the school, and breaks environmental rules, which might bring negative impacts in the education system of our country [41, 43].

IV. CONCLUSIONS

Noise pollution is increasingly prevalent in the educational institutions of Dhaka City, crossing noise standards and adversely affecting both human health and the environment. In the studied educational institutions, the overall mean noise level and Leq were determined to be 74 dBA and 79.02 dBA, respectively. The order of noise pollution level in the educational institutions of Dhaka City is Rajuk Uttara Model College > Bhuiyan Ideal School > Talimul Qu'ran School and Madrasha > Kallyanpur Girl's School and College > Green University of Bangladesh > Al Madinah Cadet Madrasa > BAF Shaheen College, Tejgaon > Tanjimul Ummah Alim Madrasha > Sir Salimullah Medical College > Bhashantek Govt. Secondary School > Jannatul Ma'owa Madrasha > Khilkhet Technical College > South Breeze School > Full Bright English Medium School > Mirpur College > European University of Bangladesh > Prime University > World University of Bangladesh > East-West International School > Uttara University. According to Leq value, the three educational institutions with the highest noise pollution levels were Rajuk Uttara Model College (100.76 dBA), Bhuiyan Ideal School (89.39 dBA), and Talimul Qu'ran School and Madrasha (88.52 dBA). Conversely, the three educational institutions with the lowest noise pollution levels were recorded at Uttara University (68.93 dBA), European University of Bangladesh (70.22 dBA), and Khilkhet Technical College (72.39 dBA) in terms of Leq. The findings of this research indicated that noise levels at each educational institution were above the allowable national guideline. Noise pollution is a substantial environmental issue in Bangladesh, particularly in Dhaka City, which houses around ten million residents, among other major metropolitan areas and rapidly expanding semi-urban locales. A World Bank study indicates that diseases and premature fatalities resulting from noise pollution incur an annual economic burden of several hundred million dollars. The study inspires broader implications for future research in the educational institutions of Dhaka City and has demonstrated the need for improved noise quality monitoring.

ABBREVIATIONS

AC: Alternating Current
CAPS: Center for Atmospheric Pollution Studies
dBA: A-weighted Decibel
GB: Gigabyte
GIS: Geographic Information System
Govt.: Government
Leq: Equivalent Continuous Sound Pressure Level
MAX: Maximum
MIN: Minimum
NIHL: Noise-Induced Hearing Loss
PC: Personal Computer
REC: Record
SD: Secure Digital
SPSS: Statistical Package for the Social Sciences
WHO: World Health Organization

ACKNOWLEDGMENTS

CONFLICTS OF INTEREST

The authors assert that they do not have any conflict of interest with this study. They are satisfied with their position.

AUTHOR'S CONTRIBUTION

AHMAD KAMRUZZAMAN MAJUMDER
Conceptualization, Research Design, Investigation, Writing - original draft, Data Analysis, Editing, Validation.

MOHAMMAD RAKIBUL ISLAM
Conceptualization, Data Collection, Writing - original draft, Editing, Validation.

REFERENCES

[1] Islam Z, Abdullah F, Khanom M. Evaluation of traffic accessibility condition and noise pollution in Dhaka City of Bangladesh. Am J Traffic Transport Engineer. 2021;6(2):43-51.

[2] Rao PR, Rao MGS. Community Reaction to Road Traffic Noise. Applied Acoustics. 1992; 37: 51-64.

[3] United Nations Environment Programme (UNEP). Frontiers 2022: Noise, Blazes and Mismatches – Emerging Issues of Environmental Concern. Nairobi: UNEP; 2022.

[4] Emran MGI, Mahmud S, Khan AH, Bristy NN, Das AK, Barma R, Barma A, Mita MH, Bosunia L, Rahman M, Roy M. Factors Influencing Stress Levels Among Students: A Virtual Exploration. European Journal of Medical and Health Sciences. 2024;6(6):67-75.

[5] Alam MJB, Rauf, AFMA, Ahmed, MF. Traffic induced noise pollution in Dhaka City. J Civil Engineer. 2001;29(1):1-9.

[6] Emran MGI, Ahmed KT, Khan AS, Rahman L, Momin MH, Das AK, Akter S, Saha M, Banerjee S, Ahmed T, Islam AFMM. Positive impacts of COVID-19 Lock down in Bangladesh: An online investigation. Heliyon. 2023;9(10):1-14.

[7] Wongsurakiat P, Maranetra KN, Nana A, Naruman C, Aksornint M, Chalermsanyakorn T. Respiratory symptoms and pulmonary function of traffic policemen in Thonburi. J Med Assoc Thailand Chotmaihet Thangphaet. 1999;82(5):435-43.

[8] Karita K, Yano E, Jinsart W, Boudoung D, Tamura K. Respiratory symptoms and pulmonary function among traffic police in Bangkok, Thailand. Arch Environ Health. 2001;56(5):467-70.

[9] Shrestha I. Health effects of vehicular noise pollution on traffic police personnel in Kathmandu. Dissertation. Kolkata: Department of Environment Science, St Xavier's College, 1998.

[10] Shakya S. Health problems prevalent in the traffic police personnel due to vehicular air pollution in Kathmandu. Dissertation. Kathmandu: St Xavier's College, 2001.

[11] Tamura K, Jinsart W, Yano E, Karita K, Boudoung D. Particulate air pollution and chronic respiratory symptoms among traffic policemen in Bangkok. Arch Environ Health. 2003;58(4):201-7.

[12] DeToni A, Finotto L. Respiratory diseases in a group of traffic police officers: Results of a 5-year follow-up. Giornale Italiano Med Lavoro Ergonomia. 2005;27(3):380-2.

[13] Tripathi SR, Tiwari RR. Self-reported hearing quality of traffic policemen: A questionnaire-based study. Indian J Occupat Environ Med. 2006;10(2):82-4.

[14] Majumder AK. Noise induced hearing quality assessments of traffic police personnel in Dhaka City. J Environ Pollut Human Health. 2018;6(4):121-5.

[15] Majumder AK, Bhuiyan, ML, Akter, S. Status of noise pollution in different silent zone of Lalmatia residential area of Dhaka City. J SUB. 2016;6(1):81–91.

[16] Majumder AK. Health impact assessment of noise pollution on traffic policemen of Kathmandu Valley, Nepal. Stamford J Environ Hum Habitat. 2012;1:120–32.

[17] Majumder AK, Rauniyar R, Carter WS, Khanal SN, Bajracharya RM, Joshi SK. Noise induced hearing loss of Kathmandu valley traffic police: A self reported occupational health study. Bangladesh J Environ Sci. 2010;18:77-82.

[18] World Health Organization. The world health report 2002: Reducing risks, promoting healthy life. Geneva: World Health Organization, 2002.

[19] Nandi SS, Dhatrak SV. Occupational noise-induced hearing loss in India. Indian J Occupat Environ Med. 2008;12(2):53-6.

[20] National Institute for Occupational Safety and Health. Criteria for a recommended standard: Occupational noise exposure. Cincinnati, OH: National Institute for Occupational Safety and Health, 1998.

[21] World Health Organization. Occupational and community noise. Geneva: World Health Organization, 2001.

[22] Islam, KMN, Majumder AK, Biswas, JD, Paul, B. Assessment of citizens perception towards traffic noise induced hearing loss in Dhaka City. Stamford J Civil Engineer. 2011;3(1):22-30.

[23] Berger EH, Royster LH, Rozster JD, Driscoll DP, Layne M, eds. The noise manual, 5th ed. Fairfax, VA: American Industrial Hygiene Association, 2000.

[24] Goelzer B, Hansen CH, Sehrndt GA, eds. Occupational exposure to noise: Evaluation, prevention and control. Geneva: World Health Organization, 2001.

[25] Murthy VK, Majumder AK, Khanal SN, Subedi DP. Assessment of traffic noise pollution in Banepa, a semi urban town of Nepal. Kathmandu Univ J Sci Engineer Technol. 2007;3(2):12-20.

[26] Bluhm G, Nordling E, Berglind N. Road traffic noise and annoyance: An increasing environmental health problem. Noise Health. 2004;6(24):43-9.

[27] Meijer H, Knipschild P, Sallé H. Road traffic noise annoyance in Amsterdam. Int Arch Occupat Environ Health. 1985;56:285-97.

[28] Ouis D. Annoyance caused by exposure to road traffic noise: An update. Noise Health. 2002;4(15):69-79.

[29] Öhrström E. Longitudinal surveys on effects of changes in road traffic noise—annoyance, activity disturbances, and psycho-social well-being. J Acoust Soc Am. 2004;115(2):719-29.

[30] De Hollander AE, van Kempen EE, Houthuijs DJ, Van Kamp I, Hoogenveen RT, Staatsen BA. Environmental noise: an approach for estimating health impacts at national and local level. Geneva: World Health Organization, 2004.

[31] Majumder AK, Jilani MG. Assessing the Noise Pollution Level in Cumilla District Town, Bangladesh. GSC Advanced Research and Reviews. 2025;23(3):204-217.

[32] Majumder AK, Bhuiyan MTA. Assessing the Extent of Noise Pollution in Laxmipur District Town, Bangladesh. International Journal of Environmental Monitoring and Analysis. 2025;13(2):61-73.

[33] Majumder AK, Paul A, Ahamed MR. Assessment of Noise Pollution in Khulna City, Bangladesh. Am J Environ Sci Eng. 2025;9(2):86-97.

[34] Majumder, AK, Mohammad, N. Evaluating the noise pollution levels in Feni District Town, Bangladesh. International Journal of Multidisciplinary Research and Development. 2025;12(7):52-60.

[35] Majumder, AK, Sirajee, HMNH. Assessing the level of noise pollution in the town of Pabna, Bangladesh. International Journal of Academic Research and Development. 2025;10(4):13-21.

[36] Majumder AK, Ullah MA, Shiddiqua S. Evaluation of Noise Pollution in Barisal, a Coastal City of Bangladesh. International Journal of Sustainable Development Research. 2025;11(3):166-179.

[37] Majumder AK, Hossain MM, Hossain T. Evaluating the Level of Noise Pollution in the Town of Sirajganj, Bangladesh. International Journal of Sustainable and Green Energy. 2025;14(3):182-194.

[38] Environmental Conservation Rules. Dhaka: Ministry of Environment and Forest, Government of the People's Republic of Bangladesh, 2006.

[39] Shield BM, Dockrell JE. The effects of noise on children at school: A review. Building Acoustics. 2003;10(2):97–116.

[40] Basner M, Babisch W, Davis A, Brink M, Clark C, Janssen S, Stansfeld S. Auditory and non-auditory effects of noise on health. The Lancet. 2014;383(9925):1325–32.

[41] World Health Organization (WHO). Environmental Noise Guidelines for the European Region. Geneva: WHO Regional Office for Europe; 2018.

[42] Ronsse LM, Wang LM. Effects of noise from building mechanical systems on student achievement and teacher response. J Acoust Soc Am. 2010;128(5):3108–19.

[43] Evans GW, Lepore SJ. Nonauditory effects of noise on children: A critical review. Child Environ. 1993;10(1):31–51.