

## A Review of Environmental Noise Pollution and Impacts on Human Health in Rajshahi City, Bangladesh

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### Abstract

Noise pollution refers to excessive, unwanted, or disruptive sound in the environment. It can originate from various sources, such as road traffic, air traffic, railways, construction, using loudspeakers, industrial operations, and even household appliances. The purpose of the study was to review noise pollution and its effects on human health in Rajshahi City, Bangladesh. Most of the studies identified that the main source of noise pollution in the city is road traffic noise. The city is at a crossroads with prominent national as well as educational institutions like Rajshahi University, Rajshahi College, Varendra Museum, Bank of Padma River, Rajshahi University of Engineering and Technology, Hospital and Diagnostic Centre, BSCIC Industry, and numerous other educational institutions. All studies showed that noise pollution levels higher than the recommended acceptable limits were detected in various areas. Exposure to high levels of noise causes stress on human health, such as auditory, hearing, and nervous system damage, reducing productivity, insomnia, sexual impotency, respiratory, cardio-vascular, neurological, and outing damages, and limiting human life. It is recommended that affected sites develop a practical management approach for reducing noise pollution.

### Keywords

Noise Pollution, Environmental Noise Pollution, Human Health, Mental Health, Rajshahi City

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## 1. INTRODUCTION

Noise pollution is defined as the presence of excessive, unwanted, unpleasant, loud, or disruptive sound in the environment (Mesene et al., 2022), has become an environmental issue that is increasing globally and has become a significant concern for the public health sector. According to a study conducted by the Department of Environment (DoE) of Bangladesh, noise pollution in the country's urban areas has exceeded the permissible limit set by the government, with the city of Dhaka being the most affected and the second highest-affected city Rajshahi (Khan and Ahmed, 2023). This environmental concern has been relevant in developing countries, where rapid industrialization and urbanization have caused a massive increase in sound pollution (Nwe, 2019; Kalawapudi et al., 2020). In Rajshahi City, the increasing use of battery-operated auto-rickshaws has raised concerns about their potential to generate high levels of noise, which can have adverse effects on public health and quality of life.

Nowadays, Noise is considered a major public health issue (Baudin et al., 2021). Not only in Bangladesh but also all over the world noise is the most common environmental exposure. WHO declared its first priority list of environmental stressors that influence the public health of city dweller. The population is increasing day by day. As the population grows, so does the demand for our air, road, and rail vehicles. As a result, noise pollution is increasing day by day (Hien et al., 2020; Lagonigro et al., 2018) and decreasing available space for citizens. So, how can noise pollution be kept within tolerable limits in the future makes everyone wonder. It has become one of the aspects of urban development and policies. Noise has various adverse health impacts on human health including annoyance, sleep disturbance (Basner and McGuire, 2018; Nassur et al., 2019), cardiovascular disease (Van Kempen et al., 2018; Evrard et al., 2015), decreased physical activity (Münzel et al., 2021), promote obesity, increase the risk of type two diabetes, possible to relate to anxiety and depression and decrease cognitive performance

among children (Thompson et al., 2022). Various epidemiological evidence suggests that transportation noise affects human health in various ways. Transportation noise affects the sympathetic nervous system and endocrine arousals that release stress hormones in the bloodstream (Münzel et al., 2021). Further, it creates annoyance, affects health-related quality of life (Han, 2020), and reduces sleep quality (Münzel et al., 2021; Riedy et al., 2021).

Rajshahi is a major urban, administrative, commercial, cultural and educational city and a large metropolitan city in Bangladesh (Das et al., 2017). It is also the main centre of silk. Rajshahi, the capital of the Rajshahi Division province, is the 4th most populated city in Bangladesh. It serves as the administrative headquarters for the division and district of the same name. It comprises 30 wards, and the total area is 96.72 sq. km. The total population of Rajshahi City Corporation is about 89 million (Murad et al., 2022), with a population density of 4,318/Sq. Km in 2023. The satellite towns of Nowhata and Katakhal, which together have a combined population of about 1 million, surround the town. Rajshahi is located in the Barind Tract at 24° 22' 26" N and 88° 36' 04" E. It is bounded on the east, north, and west by the Paba Upazila (a subdivision of a district) of the district. Nearly all countries in the world currently experience challenges with environmental degradation like noise pollution. Road traffic, aircraft, construction machinery, and manufacturing activities are a few of the main sources of this unpleasant sound. In the past, Rajshahi City had slow-moving vehicles, namely bicycles, rickshaws, etc., but at present, the scenario has completely changed, and city traffic is largely occupied by battery-powered auto-rickshaws and others generating noise pollution.

### 1.1 Road Network

The road network of Rajshahi City has been divided into three types: (1) national and regional highway roads; (2) main city connection roads; and (3) local roads. In the present research, the noise pollution data was collected based on secondary information in the busy traffic area, silence zone, residential zone, commercial zone, mixed zone, and important intersections of Rajshahi City during the period from 2013 to 2023.

### 1.2 Commercial and Non-commercial Traffic Value

Commercial vehicles include trucks, buses, utility vehicles, auto-rickshaws, and rickshaws, and non-commercial vehicles include private cars, motorcycles, and bicycles. The percentage of commercial and non-commercial vehicles is 63% and 37%, respectively. The average annual growth rate of vehicles in both categories is 6.1%. The road is shared by eight major types of vehicles. These are trucks, buses, utility vehicles, cars, autorickshaws, motorcycles, bicycles, and rickshaws.

## 2. EXPERIMENTAL SECTION

A literature search of the PubMed, Google Scholar, ResearchGate, Scilit, and Web of Science databases was carried out from January 1<sup>st</sup>, 2013 to July 31, 2023, by entering the following search keywords. We included both original and other research evaluating the relationship between various sources of noise pollution and psychological well-being. We excluded commentaries and letters to the editor. We included all types of research, both original papers and conference papers, conducted in Rajshahi on assessing noise levels of pollution in various important points of the city and their effects on physical and mental health.

### 2.1 Searching Words

1. Noise pollution in Rajshahi
2. Sound pollution in Rajshahi
3. Assessment of noise level in Rajshahi
4. Assessment of sound level in Rajshahi
5. Determination of noise level in Rajshahi
6. Determination of sound level in Rajshahi

### 2.2 Inclusion Criteria

1. Search done at PubMed, Google Scholar, ResearchGate, Scilit, and Web of Science databases
2. Included both original article and conference paper
3. Full downloadable paper in PDF form.
4. Time range between January 1<sup>st</sup>, 2013 to July 31<sup>st</sup>, 2023
5. Papers that discussed about noise/sound pollution/level in Rajshahi
6. English language

### 2.3 Exclusion Criteria

1. Commentaries, and letters to the editor.
2. Articles that discussed about noise/sound pollution/level out of Rajshahi
3. Without English language

## 3. RESULTS AND DISCUSSION

We found only five papers (Table 1). Among the papers, only one is the original article and the remaining four are conference papers. Because of only five papers, we discussed all the papers below. The first paper was conducted by Khan and Ahmed (2023). This study aimed to assess the noise levels in several areas of Rajshahi City and look into the potential noise pollution effects of battery-operated autorickshaws. This investigation was carried out in Rajshahi, Bangladesh, in 2022 and 2023 to assess noise levels at five particular sites. Talaimari and Laxmipur were considered to be in the silent zone during the study, Rail Gate and Shaheb Bazaar Zero Point to be in the commercial zone, and BSCIC to be in the industrial zone by Bangladeshi rules (Khan and Ahmed, 2023). In Bangladesh, the quiet zone's maximum permissible noise level is 50 dB (A), the commercial zone is 70 dB (A), and the industrial zone is 75 dB (A) (Khan and

**Table 1.** Data Characteristics

Serial No.	Types of Article	Author	Objectives
1	Original article	<a href="#">Khan and Ahmed (2023)</a>	Assessment of noise pollution and remediation
2	Conference paper	<a href="#">Bari et al. (2018)</a>	Determination of noise level at Rajshahi Medical College and nearby roads
3	Conference paper	<a href="#">Das et al. (2017)</a>	Assessment of sound level at different places including hospitals, residential areas, educational institutions
4	Conference paper	<a href="#">Bari et al. (2017)</a>	Determination of noise level of Different Places
5	Conference paper	<a href="#">Bari et al. (2016)</a>	Noise level of important places

[Ahmed, 2023](#)). According to the survey, noise levels in Rail Gate and Shaheb Bazaar were about 25% above the limit, while noise levels at Talaimari and Laxmipur were almost 75% higher than the Bangladesh standard. The study also examined the noise levels of auto-rickshaws using the TT Horn and Plastic Air Horn, and it discovered that while the TT Horn's noise level was higher than the limit, the Plastic Air Horn's noise level was lower than the limit. The study emphasizes the necessity for laws to limit noise pollution in Bangladesh and offers potential solutions for lowering auto-rickshaw noise levels.

Measurements were taken at 0.5 m (45 degrees from the source), 7.5 m, 10.0 m, and 20.0 m to determine the strength of both horns, according to Bangladesh's S.R.O. 212-law/2006 ([Khan and Ahmed, 2023](#)). The number of auto-rickshaws as a local transportation option has expanded with the growth in urbanization and population. As a result, there is now more noise pollution, which can cause serious health concerns like heart attacks and hearing loss. The excessive use of horns by autorickshaws and other vehicles must be strictly enforced. Rajshahi City can remain a lovely and healthy place to live by taking the necessary steps to prevent noise pollution. The study did not mention any limitations.

The second paper was conducted by [Das et al. \(2017\)](#). The purpose of this research was to measure the noise levels in several zones of Rajshahi city. In comparison to the standards, the study tries to quantify the noise levels that have surpassed the allowable limit at particular types of sources. The article also makes recommendations for essential actions that could be taken to keep the sound level within the permitted range. During the day between 9 a.m. and 12 p.m., the authors measured the sound levels at several locations, including hospitals, residential areas, schools, and colleges, using a sound level meter. The DoE-permitted standards were compared to the measured sound level. According to the article, Rajshahi City's measured sound levels were often higher than the acceptable thresholds suggested by the ([Khan and Ahmed, 2023](#)). The study indicated that as urbanization, industries, and vehicle traffic increase, noise pollution in Rajshahi City worsens both the public's physical

and mental health. The study found that in metropolitan areas in Bangladesh, especially Rajshahi city, sound levels almost universally exceeded the acceptable thresholds ([Khan and Ahmed, 2023](#)). In order to keep the noise level within the acceptable range, the study suggested several necessary actions, including speed limits, awareness, introducing new horns, noise-reducing streets, weight limits, coordination of traffic lights at intersections to clear traffic, construction of new road segments, tree planting, new window frames, etc. No particular study constraints are mentioned in the publication. The article advises that to avert these negative impacts, the authorities must act immediately to regulate the noise pollution in Rajshahi City.

The third paper was conducted by [Bari et al. \(2016\)](#). The purpose of this study was to evaluate the noise pollution caused by traffic in Rajshahi and make suggestions for how to decrease it. The study identified the worst sound pollution hotspots and suggested solutions in light of the findings. The results of this study could be applied to the traffic management and urban development of this metropolis. The purpose of this study is to contribute to the design of the traffic flow system and urban planning of Rajshahi City by offering a method to lower the noise level in the city. There isn't a thorough explanation of the study's methodologies in the paper. However, it states that ten significant road crossings were chosen as study locations to evaluate the noise caused by transportation activities in Rajshahi City. The sound level meter was used to measure the noise level and traffic volume to determine whether there was a relationship between them. The document lists the highest noise levels at particular study points. Bhodra More recorded the loudest noise at 105.2 dB, and Alupotti More recorded the quietest at 93.8 dB. At Talaimari More, Rail Gate, Bhadra More, and Kashiadanga, the noise levels are all above 100 dB. The study's two working days and one holiday may not have been sufficient to adequately capture the range of noise levels throughout the week. Other noise sources that might contribute to the city's overall noise pollution, such as factories, construction sites, and households, were not considered in the study. The effectiveness of the suggested mitigation measures may be hampered by the

study's inability to link traffic volume and noise levels. The impact of noise pollution on the city's ecology and wildlife was not considered in the study. According to the report, noise pollution poses a threat to one's physical and mental health. The impact of noise pollution on physical and mental health, however, is not specifically discussed in the research.

The fourth paper was conducted by Bari et al. (2018). The purpose of this article was to quantify the level of internal noise at Rajshahi Medical College Hospital. Using a digital sound level meter, the study evaluated the noise levels in 11 various types of wards (divided based on types of clinical treatment) and the roads around them every 30 minutes on two working days and one holiday from 8 a.m. to 8 p.m.

The study found that the average maximum noise levels in all of the wards ranged from 71.68 dB to 75.41 dB. The World Health Organization (WHO) regulation for noise levels is 45 dB for a silent area, yet it was found that every ward had noise levels that were almost twice as loud. The Child Care Unit (Ward No. 24) has the loudest sounds of youngsters sobbing and crying. The paper concludes that due to the excessive noise levels at the hospital, patients' health and welfare may suffer. The consequences of noise pollution on physical and mental health were not specifically discussed in the research. It is commonly known that noise pollution has negative effects on human health, including hearing loss, sleep disturbances, stress, anxiety, and raised blood pressure. Loud noise levels in hospitals may impede patients' ability to heal and increase the risk of medical errors. As a result, reducing noise pollution in hospitals is essential to maintaining a secure and hygienic environment for patients, employees, and visitors. According to the paper's conclusion, the level of noise pollution at Rajshahi Medical College Hospital is intolerable and detrimental to the health and wellness of patients, doctors, nurses, and other facility visitors. The management of the hospital should consider the unwarranted noise level to be a serious health hazard and take the necessary steps to decrease it. These restrictions include the possibility that the results cannot be extended to hospitals in Bangladesh or other countries as the study was only conducted at one institution. The study may not have had enough time to adequately evaluate the level of noise pollution in the hospital in just three days. The study did not examine the origins of hospital noise pollution, which would have provided more information on how to reduce noise levels. The study did not look at the long-term effects of noise pollution on patients' health and well-being, which would have provided greater insight into the seriousness of the problem.

The fifth study by Bari et al. (2017), published in 2017, was discussed. The goal of this paper was to identify the noise pollution brought on by vehicles at ten different locations. To measure the noise levels, a digital sound level meter was employed. The research points were selected

throughout the full stretch of the road in order to measure the noise level at a location other than the road intersection, which had already been investigated and published elsewhere (Bari et al., 2016). The noise levels at all 10 locations in Rajshahi city were much higher than the permitted range of 85 dB for regions with heavy traffic (Khan and Ahmed, 2023). The zone with the highest noise level, 107.3 dB, was found to be Kadirganj. Laxmipur bypass has the lowest average noise level (52.3 dB). According to the study, laws prohibiting the use of horns, especially hydraulic horns, and educating the public about the problem of noise pollution may go a long way toward resolving the issue. Planners and decision-makers can use the study's findings to guide appropriate actions. An important step in resolving the problem would be to increase public awareness of the habit of honking.

Rajshahi City's many locations have noise levels that are above what is reasonable and cause annoyance, endangering people's physical and mental health. One of the main sources of noise in metropolitan environments is battery-powered auto-rickshaws. According to this study, Kadirganj, Chistia Mess Gate, and Laxipur bypass are the locations with the highest noise levels, with Kajla, Medical Banda Gate, Hadir More, and Barendra Museum More being acute locations with noise levels over 100 dB. Since the study was only conducted in Rajshahi, the findings might not be generalizable to other towns or countries. The noise levels may have changed over the course of the year or day because the study was conducted over a certain period. The study ignored socioeconomic elements that may affect the level of noise pollution, the health effects of noise pollution on locals, and the effectiveness of various noise control measures in different areas of the city. According to the study, noise pollution poses a risk to both one's physical and mental health. The specific impacts of noise pollution on physical and mental health are not covered in detail, though. The study primarily focuses on measuring noise levels at several sites in Rajshahi City and makes some recommendations for noise pollution reduction. To learn more specifically about how noise pollution affects both physical and mental health, future studies are required.

### 3.1 Measured Area and Noise Level

Table 2 presents sound level measurements at 22 points within the city, classified into four types of areas: traffic area (TA), mixed area (MA), quiet area (QA), and industrial area (IA). The measurements were carried out during the day and night, with daytime being defined as 6 a.m. to 9 p.m. and nighttime being 9 p.m. to 6 a.m. The maximum (Max.), minimum (Min.), and average (Ave.) noise levels are provided, along with the type of area for each location.

In terms of Busy Traffic Areas (TA), researchers found that the maximum daytime sound levels range from 99 dB to 107 dB; the minimum range is from 52 dB to 66 dB; and the average range is from 82 dB to 105 dB. The locations in TA



**Figure 1.** Map of Rajshahi City (Source: Google Map)

include Kajla, Talimari More, Bhorda More, Rail Station, Laxmipur Bypass, Kadirgonj, Rail Gate, and Kashiadanga More.

But in terms of mixed areas (MA), researchers found that the maximum daytime sound levels range from 94 dB to 106 dB; the minimum range is from 53 dB to 68 dB; and the average range is from 84 dB to 103 dB. Areas of MA include Hadir More, Medial Bandho Gate, New Govt College, Court, Alopurtti More, Saheb Bazer, and Monichottor More.

On the other hand, concerning Quiet Areas (QA), the maximum daytime sound level is 82 dB; minimum level is 60 dB; in the places of QA, RMCH Indoor (Rajshahi Medical College Hospital Indoor). On the other hand, in terms of Industrial Areas (IA), the average daytime sound level is 74 dB. The location in IA is BSCIC (Bangladesh Small and Cottage Industries Corporation).

### 3.2 Map of Rajshahi City

Various important points and intersections in Rajshahi have been marked on the Google map (Figure 1). According to Table 2, different places are numbered and marked on the map. I got these places from the reviewed papers. The authors measured sound levels at these locations.

According to the above data, it is apparent that sound levels in several Rajshahi City locations frequently surpass those that are advised for particular locations. Traffic and mixed-use areas typically have higher noise levels, putting locals at risk for health problems brought on by noise pollution. Hospitals, for example, maintain relatively low sound levels because they are silent. This analysis emphasizes how crucial it is to address noise pollution in Rajshahi City and put in place the necessary controls to lessen its adverse effects on human health, particularly in high-traffic and mixed-use areas.

### 3.3 Noise Pollution Analysis

Rajshahi has achieved a good reputation at home and abroad as a green city (Osmani and Hossain, 2020), a clean city, a

city of light and a city of clean air. But in various reports of 2022, Rajshahi City has been called the 4<sup>th</sup> most noise-polluted city (Khan and Ahmed, 2023) in the world. The amount of dust in the city is also increasing as a result of the massive infrastructural development of the city. One of the reasons for increasing noise pollution is human psychology. People consider other pollution as pollution but noise pollution is not considered as pollution. Moreover, people do not know how harmful and long-lasting the negative effects of noise pollution are. To comprehend the concrete details of noise pollution in Rajshahi City, it is essential to study the road system, transport arrangement, escalating number of vehicles, and rising rate of population growth that play a vital role in the physical, social, and economic growth of the city. Rajshahi city is facing noise pollution mainly because it is the central city of Rajshahi Division, where numerous major administration agencies and people have shifted. Good career opportunities, education facilities, and other facilities are available, and hence people prefer to reside here, which puts an additional burden on the environmental scenario of the metropolitan area. As a result, noise pollution is increasing day by day.

### 3.4 Effects of Noise Pollution on Human Physical and Mental Health

Noise pollution refers to excessive, unwanted, or disruptive sounds in the environment. It can originate from various sources, such as road traffic, air traffic, construction, using loudspeakers, industrial operations, and even household appliances (Sultana et al., 2022). Exposure to excessive noise can have adverse effects on physical and mental health, as well as on wildlife and the overall quality of life. Noise pollution can have various adverse effects on both human health and the environment (Baudin et al., 2021). Some of the most common effects include: Prolonged exposure to loud noise can lead to permanent deafness or hearing loss (Rahman et al., 2022; Sultana et al., 2022). Constant exposure to loud or unwanted noise can cause stress, anxiety,

**Table 2.** Study Sites and Noise Levels Included in the Review

Author(s) Study Year Zone/points	Bari et al. (2016)		Bari et al. (2017)		Khan and Ahmed (2023)		Type of Area
	2016	2016	2017	2017	2021	2022	
	Max.	Min.	Max.	Min.	Ave.	Ave.	
(1) Kajla			103	59			TA
(2) Talimari More	104	65			84	86	TA
(3) Bhorda More	105	64					TA
(4) Rail Station	104	66					TA
(5) Chistia mess			106	53			TA
(6) Hadir more			103	53			MA
(7) Barendra Museum			102	56			TA
(8) Sagorpara			100	57			RS
(9) Medial Bandho gate			102	57			MA
(10) Laxmipur bypass			105	52			TA
(11) New govt college			99	59			MA
(12) Kadirgonj			107	61			TA
(13) Court			95	56			MA
(14) Rail Gate	102	65			90	90	TA
(15) BSCIC					74	72	IA
(16) Laxmipur more	99	66			90	89	QA
(17) C & B More	96	57					TA
(18) Alopurtti More	94	58					MA
(19) Saheb bazer	96	66			88	87	MA
(20) Monichottor More	99	68					MA
(21) Kashiadanga More	102	64					TA
(22) RMCH indoor	82	60					QA

[TA = Traffic Area; MA = Mixed Area; QA = Quiet Area; IA = Industrial Area; Max.: Average maximum noise level at different points; Min.: Average minimum noise level at different points; Ave.: Average noise level at different points; and RMCH: Rajshahi Medical College Hospital Indoor]

**Table 3.** The Acceptable Noise Levels for Different Areas Recommended by the Government of Bangladesh (GoB)

SL	Area	Day time	Night time
1	Quiet area*	45 dB	35 dB
2	Residential	50 dB	40 dB
3	Mixed area**	60 dB	50 dB
4	Commercial	70 dB	60 dB
5	Industrial	75 dB	70 dB

\*A sensitive area where quietness is of primary importance, such as schools, hospitals, mosques, etc.

\*\* Mixed areas, which are, used as residential areas as well as commercial and industrial purposes Daytime means time between 6 a.m. to 9 p.m. and Night time means 9 p.m. to 6 a.m.

depression, irritability, and feelings of hopelessness, which can lead to countless health problems (Rahman et al., 2022; Baudin et al., 2021; Ma et al., 2018). Noise pollution can disrupt sleep patterns and cause insomnia, leading to fatigue and decreased productivity (Ma et al., 2018). It can increase blood pressure, heart rate, and the risk of heart attack and stroke, increasing the risk of cardiovascular disease (Banerjee, 2014; Sørensen et al., 2023; Rahman et al., 2022).

It can also cause stress and disorientation in animals, leading to habitat loss and population decline. Noise pollution can decrease the value of real estate, making it harder to sell or rent properties. The constant noise in the workplace can make it difficult to concentrate and decrease productivity (Rahman et al., 2022; Peris, 2020). Noise pollution has been linked to a variety of adverse effects on mental health, including increased stress, anxiety, difficulty sleeping, and an increased risk of depression (Rahman et al., 2022; Sultana et al., 2022; Ma et al., 2018). Studies have shown that exposure to excessive noise can disrupt the body's stress response, leading to increased levels of cortisol and other stress hormones in the body. Noise pollution can interfere with concentration and memory, making it difficult to complete tasks or retain information, especially for children. Noise pollution can disrupt the balance of neurotransmitters in the brain, leading to changes in mood and behaviour. Studies have shown that exposure to noise pollution may increase the risk of developing schizophrenia and other mental disorders. Overall, noise pollution can have a significant impact on mental health, leading to increased stress and anxiety, sleep disturbances, and mood disorders. It can also contribute to cognitive impairment and cardiovascular

disease.

#### 4. CONCLUSIONS

The study concludes that Rajshahi's traffic-related noise poses a serious threat to both the environment and human health. The study identified that Bhodra More, Rail Station, Talaimari More, Rail Gate, and Kashiyadanga, even inside the hospital, are the most noise-polluted areas in Rajshahi City. According to previous studies, the government must take the required steps right away to make things better. Additionally, the report suggested using an alternative horn to reduce the level of sound and people should be made aware. They should be informed about the adverse effects of noise pollution. A campaign against noise pollution should be carried out in electronic media, print media, and social media. At the same time, various government and private organizations and prominent people should come forward to reduce noise pollution. Drivers need to understand that honking does not make the road clear; it has no magic power. But it causes great harm to animals, including humans.

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