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Assessing the Impact of Urban Construction Activities on Urban Community Health: A Comprehensive Study on Rajshahi City

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Abstract

The steady population growth in Rajshahi City has led to an increase in construction activities to fulfill its growing infrastructural demand. The aim of this study is to assess the impacts of these urban construction activities on urban communities' physical and mental health in Rajshahi City. We applied a mixed-method approach to carry out this study. Data were collected through a semi-structured questionnaire from 150 respondents who are residing near ongoing major construction sites. This study employed the Perceived Stress Scale (PSS-10) to measure psychological stress caused by urban construction activities. Results revealed that urban construction activities significantly impact urban community health; about 62.7% of respondents face construction-related disturbance on a daily basis. Most respondents reported that construction activities mainly caused noise (95.3%) and air pollution (93.3%) in their areas, which were key causes of several health-related problems. Construction-induced noise caused disruptions in sleep and work concentration, resulting in physiological and psychological stress among urban residents. The urban community experienced several health issues, including coughing, asthma, eye irritation, throat irritation, and allergies due to construction dust (78%) generated air pollution. This study found age was significantly associated with the perceived impact of urban construction activities on the community's physical health (p value = .001) and identified that the elderly (50+) people suffered most. The outcomes of PSS-10 showed that the majority of urban residents perceived moderate levels of psychological stress (58.7%) from construction-related disturbances, and males experienced higher stress than females. This study underscores how urban construction impacts urban communities, and these findings can guide policymakers in designing localized interventions to mitigate the detrimental effects of urban construction activities.

Keywords: construction activities; noise pollution; air pollution; health risk; psychological impact; stress; urban community

Introduction

Urban areas provide a wide range of opportunities and ensure quality of life for their residents. Driven by these opportunities, people are moving from rural to urban areas across the world which resulted significant population growth in cities [1]. According to United Nations, more than half of the world population lives in cities and this proportion is projected to reach nearly 70% by 2050 [2]. Similarly, urban areas in Bangladesh are witnessing rapid population growth, with currently 40% of the population living in cities and expected to rise to 50% by 2050 [3]. As city population expand in Bangladesh, pressure on housing, transportation, and other essential infrastructure continue to rise [4]. To meet this growing infrastructural demand, major urban areas of Bangladesh are undergoing massive construction and expansion [5,6,7]. The major types of construction activities include the expansion of transport network, development of new residential and commercial buildings, and the installation of sewerage and water supply systems. Due to the various circumstances and the scale of these construction projects, their completion often requires a long period, resulting in prolonged disruptions to surrounding communities [8,9]. As a result, construction activities exert pressure on the economy, environment, social interactions, and public health, posing short-term and long-term difficulties for city dwellers. Over time, these pressures hamper the daily activities and overall quality of life of residents, contributing to both physical and mental stress [10]. In major cities such as Dhaka, Chittagong, Khulna, and Rajshahi, construction projects generate noise, dust, and air pollutants, which may contribute to respiratory problems, heartburn, fatigue, headache, stress, and other health-related issues [11,12, 13, 14,15,16]. Rajshahi, as a prominent city in the northern region of Bangladesh, has been facing rapid urban growth in recent years [17]. This city, often referred to as education and green city of Bangladesh, which has attracted large number of people to reside there, leading to a continuous increase in its urban population [18,19]. As a result, the demand for housing and infrastructure has grown sharply, resulting massive construction and development activities throughout the Rajshahi City, and the continuous expansion of built-up areas clearly reflects this trend [19,20,21]. The city's development works, i.e., road extend, residential, mega project, and public building construction, have transformed the city's face dramatically. Along with the positive changes, concerns about the health impacts of city construction works have also been raised. Urban construction activities, ranging from small-scale to large-scale infrastructural developments, involve excavation, demolition, drilling, transit of construction materials, and heavy machinery fitting. These activities can result in air and noise pollution [12,13,14].

Noise pollution can lead to direct or indirect effects on physical health, including hearing impairment. Humans may encounter atypical loudness perception and tinnitus [22]. Due to the machinery involved, construction operations like filling, cutting, site clearance, and excavation generate a lot of noise [23]. One form of sound that is considered to be one of the most prevalent environmental contaminants with detrimental effects on health is noise [24,25]. Sound is the most enduring physical pollutant in human surroundings [26]. Construction workers and nearby residents were significantly impacted by the construction activities executed with large machinery that produces significant noise pollution leading to mental anxiety, sleep disturbances, heart conditions, irritation, and potential hearing loss [26]. Students' academic performance has been substantially hampered due to noise produced by nearby construction activities [27]. Construction activities not only resulted in air and noise pollution but also produced a number of disturbances for the urban community, including traffic congestion, road blockage, temporary disruption of utilities, blocked access to public spaces, visual pollution, and restricted pedestrian movement [28]. Collectively, these construction-induced disruptions impose considerable psychological stress on urban dwellers. Working-class people and students are often not able to reach their home or workplace on time due to construction-induced traffic congestion and restricted mobility, which affects their productivity and results in time-related stress and mental discomfort [29]. Many researchers have looked at how urban construction activities affects physical health and causes environmental problems. However, very few researchers have focused on how it impacts mental health. Numerous studies have conducted in Bangladesh on noise and air pollution in the past [30,31,32], but which groups of people are most vulnerable to urban construction activities induced noise and air pollution are not well identified in the existing studies. Also, none have assessed psychological impact of urban construction

activities in Rajshahi city. We conducted this research on Rajshahi city to fill this research gap. However, for the sake of ecosystem health and human safety, pollution needs to be reduced. The Rajshahi City project was selected as the study region for this investigation because to its proximity to residential, commercial, and educational areas. The primary objective of our study is to assess the impact of urban construction activities on urban community health. The key objectives of the study are (i) To find the impact of urban construction activities on urban community health. (ii) To evaluate which groups of people are most vulnerable. (iii) To assess psychological impact of urban construction activities in Rajshahi city. In our study we find out health impact from urban construction activities. We also assess psychological impact and evaluate which groups of people are most vulnerable of this construction activities in Rajshahi city. The results of this research will assist urban planners in creating more accurate environmental noise regulation standards for particular areas and serve as a guide for personalized active noise prevention and management. This study will help to increase awareness about noise and air pollution among urban residents in Rajshahi city, thereby enabling more informed decision on personal health. The findings could provide valuable data for local authorities to develop and implement effective air quality management policies, ultimately contributing to the overall health and safety of the community.

Reviews of Study

Many researchers have studied the impact on urban construction out of them we selected the five studies reviews are below

Haseeb Haleem Shaikh et al 2023, In this study author showed that the presence of noise pollution in construction zones presents a substantial health hazards for those engaged in construction activities and individuals who stay for long durations at these locations. This research develops a questionnaire survey and gathers data from 94 participants employed in the construction sectors of Sindh to determine the key factors influencing noise pollution and solutions for reducing it on construction sites. Authors stated that four factors were identified that cause noise pollution at construction sites, which was use of heavy machinery, types of construction activities like welding, banging, and hammering, transportation vehicles, and loud communication. The majority of respondents/stakeholders concurred that the operation of heavy machinery primarily leads to noise pollution at construction sites. In this study authors found that three factors determined to contribute to noise pollution affecting health were cardiovascular problems, sleep disturbances, and hearing disabilities. The majority of respondents/stakeholders agreed that cardiovascular disease significantly affects worker health in construction site. The authors recommended that construction stakeholders implement measures to mitigate noise pollution

Verma Manvendra et al 2023, In this study the researcher represents the complex relationships between construction activities and the air quality we breathe. This study author finds out the excavation and movement of raw materials to the operation of heavy equipment and the ultimate construction stage, every phase release various contaminant into the air. This study evaluates the direct and indirect impacts of construction-associated air contamination and its effects on human well-being. The author mentioned that heavy machinery, excavation, material processing, and various construction operations lead to the emission of pollutants that can directly and indirectly affect the health of workers and surrounding communities. Author also stated that airborne pollutants and construction work can cause noise pollution, linked to stress, sleep issues, and a higher chance of cardiovascular diseases. This study explores possible mitigation strategies and offers case studies to highlight practical applications, establishing a guide for sustainable development within the construction industry.

Elaheh Pahlevan et al 2021, In this study authors stated that the development of these projects (which generally spans two to three years) adversely impacts the environment of both human and natural surroundings throughout the construction process. The purpose of this study was to investigate the risks of noise pollution due to construction among residents. In this study authors find out one of the most detrimental impacts is noise pollution and the annoying noise of the construction. This research was conducted in a residential setting near the auxiliary tunnel of line 3 metro in the Abbas-Abad area of Tehran, Iran. Authors

used William fine method to evaluated the risk. In this analysis authors found that noise pollution poses a physical hazard, and this type of hazard can endanger the human environment, including social, cultural, and health matters and natural surroundings, including flora and fauna. This study highlights the noise generated by large construction projects like the Metro Auxiliary Tunnel, combined with residential areas, ranks among the significant environmental pollutants in urban settings, posing various risks to both human health and the environment. This kind of pollution has become a major problem for residents of these areas.

Ebiwari Wokekoro 2020, In this study author investigated the general public awareness of the impacts of noise pollution on human health. Author used questionnaire survey to collect data from adult respondents through emails and their phone numbers. The results of study revealed that noise pollution adversely affects health by causing headaches, insomnia, mental health issues, decreased focus at work, and additional health problems like hearing impairment, learning challenges, strokes, high blood pressure, and reduced quality of life. This research revealed that thirty-nine participants, accounting for 63.9% of the sixty-one surveyed, reported that headache was caused by noise pollution, while forty-four (72.1%) of the sixty-one respondents indicated the same participants confirm that noise pollution is a significant factor contributing to sleeplessness. The study also revealed that twenty-nine respondents representing 47.5% of the sixty-one respondents agreed that psychological disorders are caused by noise pollution. Author showed that most of the participants are aware of the health impacts of noise pollution. Author suggested that enhancing public awareness regarding the harmful effects of noise pollution on health and the rigorous execution and enforcement of noise control regulations.

Xiao Jun et al 2016, The author had analyzed health risk of construction noise on the neighboring resident community for using the applicability of the proposed model. Authors created a quantitative model to evaluate the health impact assessment (HIA) linked to construction noise for people residing near construction zones. Author stated that noise generated by construction work has emerged as the second most significant acoustic issue. Their model categorizes health issues caused by noise into four groups cardiovascular disease, cognitive impairment, sleep disturbance, and annoyance, and disability-adjusted life years (DALYs) as a measure of damage. Their study clearly shows that noise is a significant factor contributing to health effects of building projects, as discover by the higher health risk faced by the communities neighboring the studied construction site. The researcher had analyzed among the evaluated health risk categories; sleep disruption constituted the largest proportion (more than 55%). Authors reported that the majority of complaints related to construction noise happened during the night. The second most common health threat in this scenario was cognitive impairment, possibly due to noise exposure easily challenges a juvenile's attention that was found in this study. This study highlights construction noise could bring significant health risks to the neighboring resident community. Author easily found that people from age group (45-54) are most vulnerable to construction noise, with high health risk being caused by sleep disturbance. Authors suggested that both the government and contractors ought to give particular focus to this issue.

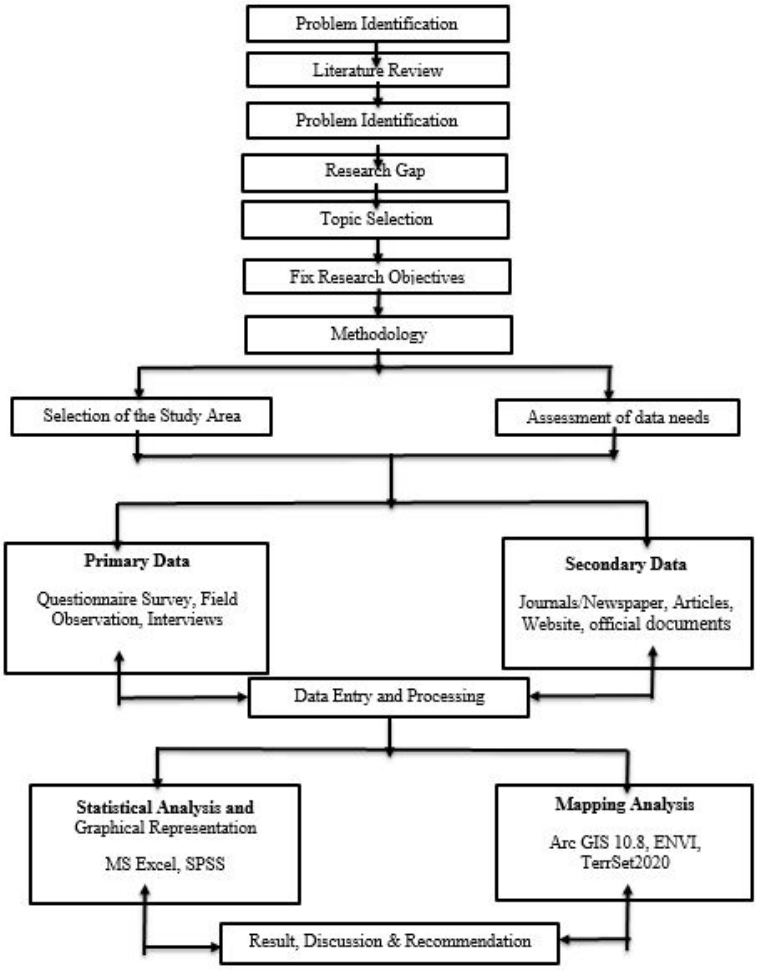
Materials and Methods

Sample Size and Sampling Method

Sample size refers to the number of observations or people included in an experiment or study. For our study, we assumed a sample size of 150 respondents. For a representative sample, we used random sampling. Random sampling is a method through which people are sampled from a population in such a manner that each population member has an equal chance of being picked. When applying random sampling, we desired to minimize bias and also ensure that our sample constitutes the characteristics of the greater population.

Data Collection

The field survey was conducted at various wards of Rajshahi city, the primary location of this study. A significant amount of data was collected directly at the site to ensure accuracy and authenticity. During data collection, the methodology employed a combination of questionnaire surveys and on-site interviews. These methods facilitated a wide range of data from respondents of different wards, alongside individuals residing in the nearby neighborhoods. A questionnaire survey with both closed-ended and open-ended question was conducted throughout the entire study area. A mixed methods approach (both quantitative and qualitative methods) was utilized to collect both quantitative and qualitative data. We collect noise measurement by decibel meter app (android version 4.4 rated) from different absolute location (with latitude, longitude) in our study area. we collected data on perceived mental stress using the PSS 10 questionnaire method, both positive and negative Likert scale that's mean five - point Likert scale. Total 150 questionnaire surveys were conducted among residents of Rajshahi city. In additio to the quantitative survey 15 qualitative interviews were conducted with key information including environmental analyst of RCC (Rajshahi city corporation), Teacher, Assistant Director of the Rajshahi Divisional Environment Department, Doctor and more. These semi structured interviews allowed participants to provide in depth insightsinto their personal experience with urban construction activities impact on urban community health and psychological impact. Data collection is a critical phase in research, involving the systematic gathering of information to address research questions. This research investigation was carried out based on primary and secondary data. For primary data collection, the researchers designed an interview schedule. The interview schedule was developed based on research objectives.



Conceptual Framework

Primary Data Collection

Primary data were mostly used in this study. In February 2025, a study was carried out through direct interviews with an interview schedule involving 150 residents of Rajshahi city and workers of mega project to collect the necessary data for the research. The interview timetable was evaluated via a pilot study. Field observations were conducted to gain a clearer insight into how does urban construction activities impact on urban community health. Researchers traveled to various construction site and mega project to study health impact by construction work, noise and air pollution by construction activities, traffic disruption by urban construction project, impact on study or schooling experience and psychological impact. We collect noise measurement by decibel meter app (android version 4.4 rated) from different absolute location (with latitude, longitude) in our study area. Alongside quantitative methods, qualitative techniques such as Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs) were performed in our study.

Secondary Data Collection

Secondary information and data were collected from diverse government and nongovernmental organizations, statistical report, published paper, articles, official documents, literature review and internet. Mapping data were collected from (USGS) USA geological survey.

Data Analysis

Data analysis is an important step in the research process, involving change or switch of raw data into meaningful data that can inform decision-making. In our study, we collected data to address specific research questions, test hypotheses, and assess how urban construction impact on urban community health. Data that were gathered by using the survey were analyzed extensively using MS-Excel and Statistical Package for Social Science (SPSS) version 20 software under computer - based analysis. A number of techniques like descriptive statistics comprising frequency counts and percentage distributions were used to interpret and understand data gathered. To analyze the data, we applied descriptive statistics, including frequency, percentage, and mean (± SD). The results are displayed in the form of tables mainly with graphs and chart. For statistical analysis, we utilized Excel and SPSS software. Excel provided a versatile platform for data organization, manipulation, and basic statistical calculations. SPSS allowed for more advanced statistical analyses, including regression analysis, hypothesis testing, and data visualization. The Pearson Chi-Square test is used to determine whether there is a significant association between two categorical variables. we used correlation analysis to identify and measure the strength and direction of relationships between variables. On the other hand, ANOVA test used to determine whether there are significant differences between the means of three or more groups. Following their collection, various relevant facts and data were openly and completely evaluated to satisfy the study's objectives. After being coded, survey data were imported into SPSS. Creating land use map and interpolation process we extensively used Arc GIS 10.8, ENVI, TerrSet2020. We also used Arc GIS 10.8 for mapping data analysis.

Result and Discussion

The construction sector significantly affects human health and the surroundings. It enhances the likelihood of various kinds of illnesses. The results of our study are below

Socio-economic and demographic information of urban residents in Rajshahi City

Table 1 highlight in percentages the socio-economic and demographic information of the participants. Of the responses received, 7.3% corresponded to the age range of 16 to 20 years, followed by 34.7% in the range of 21 to 30 years old, 28% between 31 and 40, 21.3% between 41 and 50, and 8.7% over 50. In total, 87.3% of the respondents were male and 12.7% were female. In

our study majority respondents were male. Most of the interviewers were male because it was easier to get responses from the men than the women [38]. According the occupation variables, majority were students, 28.7% respondents were businessmen, 17.3% doing non govt. job, very few respondents were Govt. job holder, 10.7% of respondents were unemployed and 8.7% were day Laboure. Regarding the education variable, 41.3% were graduate or above, both 15.3% of the respondents had completed their secondary and higher secondary education, 11.3% had completed primary education and 16.7% of respondents were uneducated. Most of the respondents had completed their graduation degree. Most of the respondents 68% in our study lives at home where 28% respondents live at apartment, 3.3% lives in slum their quality of life was very poor and almost 1% participant lives another site.

Table 1: Summary of socio-economic and demographic variables of respondents.

Variable	Category	Percentages (%)
Age	16-20	7.3
	21-30	34.7
	31-40	28
	41-50	21.3
	50+	8.7
Gender	Male	87.3
	Female	12.7
	Student	31.3
Occupation	Govt. job	3.3
	Non govt. job	17.3
	Business	28.7
	Unemployed	10.7
	Day laborer	8.7
	No formal education	16.7
	Primary	11.3
Education	Secondary	15.3
	Higher secondary	15.3
	Graduate or above	41.3
	Apartment	28
House type	House	68
	Slum	3.3
	Others	0.7

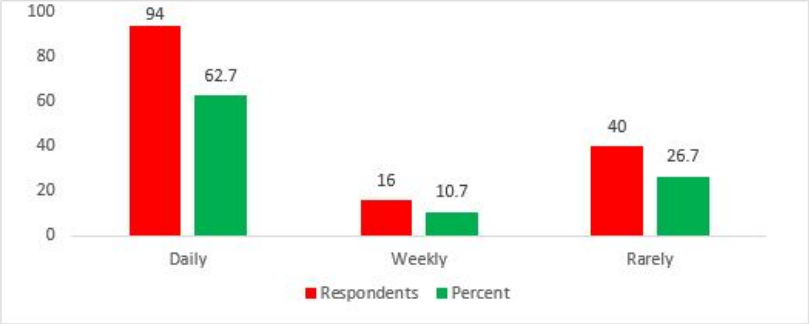


Figure 1: Experience construction-related disturbances

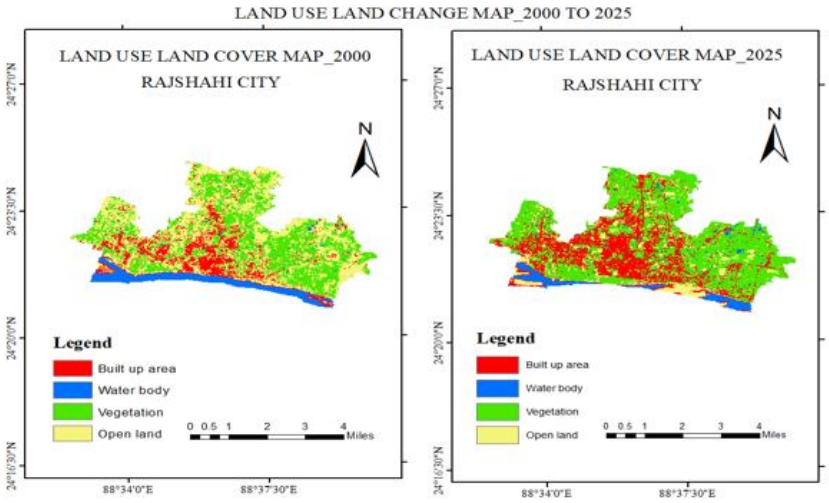


Figure 2. Land use change map

Land Use Category	Area (2000) (acres)	Area (2025) (acres)	Change (acres)
Built up area	1,685.14	5,166.17	3,481.03
Open land	4,865.57	1,708.94	-3,156.63
Vegetation	4,256.12	4,462.64	206.52
Waterbody	1,049.90	516.1	-533.8

Land use change of Rajshahi city are exposed in Figure 2, from 2000 to 2025 which illustrates extensive spatial expansion of built-up area especially in the central and southern part, expansion of urban building over former open and vegetative land. In vegetation, slight spatial movement, but coverage remains the same. possibly some plantation or green space development as restoration. From the map analysis we can see that there is a dramatic decrease of open land in Rajshahi city especially around the southern region. It specifies severe pressure from construction projects and urban sprawl. Water body exhibits noticeable shrinkage, particularly around formerly continuous water surfaces. It suggests likely encroachment or degradation due to urbanization.

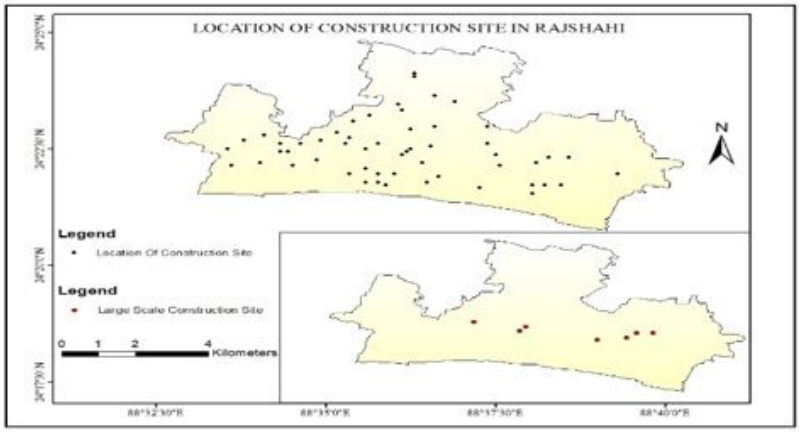


Figure 3: Spatial distribution of urban construction

Noise pollution by construction activities and impact on community health

The spatial distribution of noise in Rajshahi city during urban construction activities going on shown in figure 4. Overall, the spatial distribution of daily noise levels among varies across different buffers, with the highest values found in the core center of urban area, Rajshahi university campus, the areas of Hargram bypass in Rajshahi city, Kashiadanga, Baharampur-Terkhadia-Kalabagan-Bornali More, Kadirganj-Railgate Shalbagan-Shiroil and the northwestern part of the study region. During the study period, maximum and minimum noise level were recorded as 94.88 and 74.00 dB in Rajshahi city in the month of February. The value of noise ranged difference between 74.00 dB to 94.88 dB, averaging at 84.44 dB. Currently, regarding Bangladeshi law, there exists the Noise Pollution (Control) Rules, 2006. However, these regulations are rarely applied, and noise pollution is increasing daily. According to these Regulations, the permissible noise limit in quiet zones is 50 dB during the day and 40 dB at night; in residential zones, it is 55 dB for day and 45 dB for night; in mixed-use zones, it is 60 dB during the day and 50 dB at night; in commercial zones, it is 70 dB for day and 60 dB for night; and in industrial zones, it is 75 dB during the day and 70 dB at night. The regulations state that violating the maximum noise level in specific areas is an iniquity subject to punishment [39]. Clearly, the daily average noise level in nearly half of the urban regions of Rajshahi city surpassed the standard level. This signifies that the Noise pollution significantly impacts the well-being and living conditions of residents.

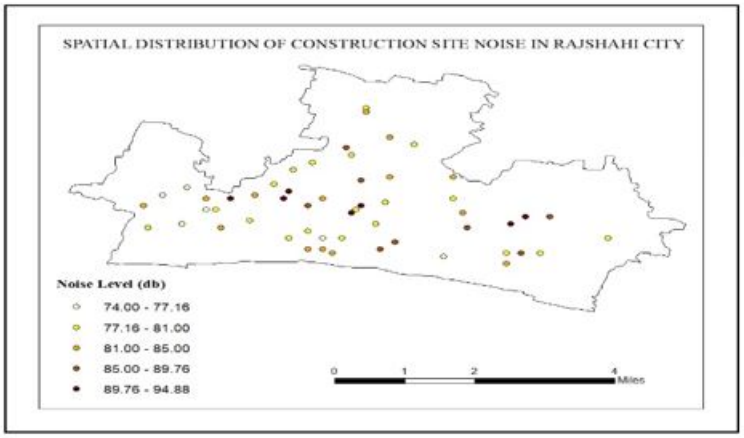


Figure 4: Spatial distribution of construction noise in Rajshahi city

The noise levels of urban construction at all sampling sites in Rajshahi city are shown in figure 5, which illustrates the intensity of the noise in the city's central locations (85-93) dB; however, the intensity decreases as one move farther from the city's center (74-82) dB The noise intensity in areas where mega projects are being carried out in Rajshahi city is very high (85-93) dB be-

cause loud equipment is used there. The noise levels produced by construction activities ranged from 76.0 to 91.5 dBA at various sites in Rajshahi City [40]. Especially in the city center, east and western parts of Rajshahi city where several mega projects are ongoing, the noise intensity is highest, with the maximum level reaching 93 dB in contrast, the noise intensity generated by the construction sites in the northern and western parts, far from the city center, is comparatively low (74-82) dB. An analysis of the noise monitoring outcomes and the survey questionnaire indicated that the construction noise threshold value causing sleep disturbances is 52 dB [41].

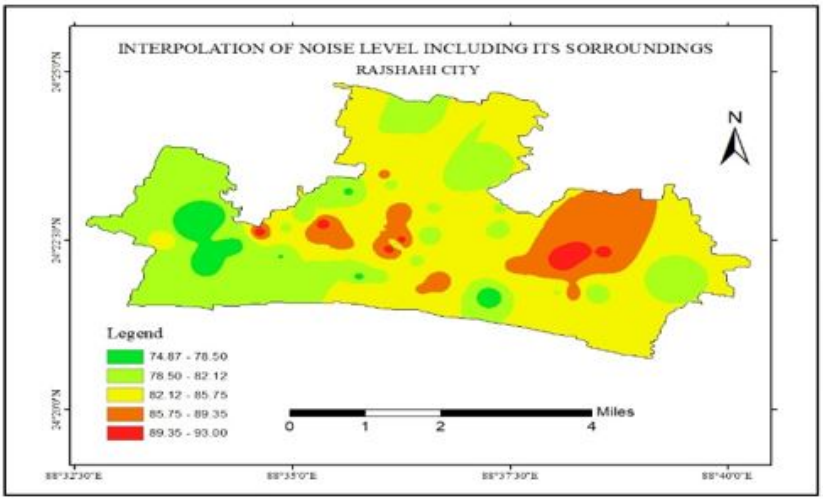


Figure 5: Interpolation of urban construction noise level of Rajshahi city

Figure 6 illustrates various construction machinery, concrete pouring, excavation and drilling or hammering was noted as a significant contributor to noise pollution at construction sites. A construction project is one of the sources of noise pollution [42]. The primary four sources of noise pollution identified by the respondents included drilling or hammering (44.7%), machinery operation (32%), huge number of respondents agreed that operating heavy machinery causes mostly noise pollution at construction sites [33], concrete pouring (30%) and excavation (20%). According to the analysis of the questionnaires illustrated in Figure 6, 44.7% participants have identified that noise pollution originates from drilling or hammering and 32% participants said that machinery operation was the major source of noise pollution. Noise pollution on construction sites, generated by welding and hammering at high sound levels, poses risks or dangers to humans and the surrounding ecosystem.

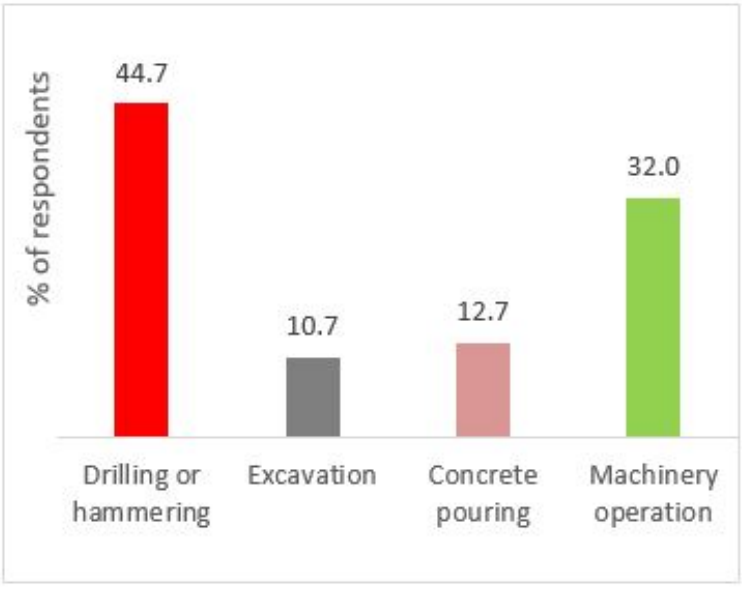


Figure 6: Major sources of Noise pollution

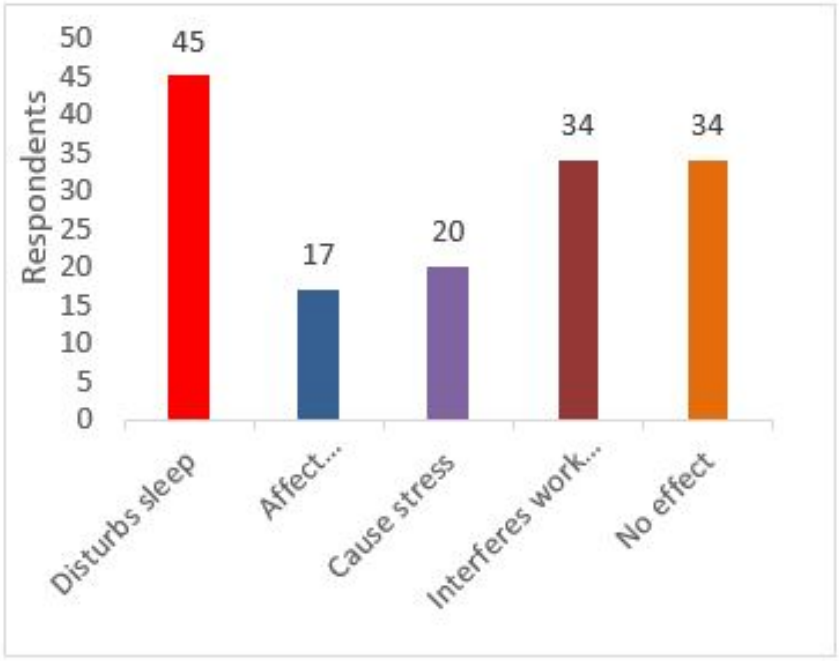


Figure 7: The impact of Noise pollution on health

Figure 7 illustrate Noise pollution from urban construction activities impact on urban community health. Several studies also confirmed that noise pollution is a major cause of sleep disturbance [43,44,45,46,47,48]. Globally, researchers have studied the negative impacts of exposure to construction noise on sleep [49,50,51]. Sleep disturbance was the first effect of noise pollution. In Sun's research [41], 98% of participants acknowledged that construction noise negatively impacted their sleep quality, 95% of respondents indicated they had been disturbed by construction noise, and 40% noted that they were often awakened. Urban communities sleep quality has a significant impact on their general health and quality of life. A variety of physical and mental health problems, including aberrant vital signs, mood disorders, a lower quality of life, an increase in health injuries, and even early mortality, are experienced by urban communities who have sleep disorders [52]. Disturbances in sleep pattern have been associated with negative psychological effects such as anxiety and depression [53]. The second impact on noise pollution was interfered work or study. Due to noise pollution from construction projects, they can't concentrate their work and students have trouble to studying. 34 respondents directly said that there was no effect of noise pollution on health. The third impact on noise pollution was stress. Continuous high levels of noise can impact stress hormones such as noradrenaline, adrenaline, and cortisol. Noise is a significant factor to trigger a headache in workers due to sleeplessness [54]. Activities that cause disturbances, such as construction work, can also lead to stress, both directly and indirectly [33]. The primary factor behind cardiovascular disease is stress, and this stress has been caused by noise pollution [55].

			Construction noise affects daily activities					
			Disturbs sleep	Affect concentration	Cause stress	Interferes work or study	No effect	Total
Age Category	16-20 years	Count	2	0	1	6	2	11
	21-30 years	Count	14	9	5	14	10	52
	31-40 years	Count	12	4	7	8	11	42

	41-50 years	Count	11	3	6	3	9	32
	50+ years	Count	6	1	1	3	2	13
Total		Count	45	17	20	34	34	150

Table 2: The Age of Respondent Vs the Effect of Noise Pollution on health

Table 2 indicates that 11 out of 150 respondents were aged between 16 to 20 years old. Six participants aged 16 to 20 years acknowledged that construction noise led to Interferes work or study, while 2 respondents reported disturbs sleep due to construction noise, 2 individuals aged between 16 and 20 years stated that there is no effect even when construction activities going on. Of the 11 respondents within this age group, 1 experienced cause stress despite their youth. The likelihood of younger adults developing hypertension is increased due to the growing prevalence of traditional risk factors like obesity, diabetes mellitus, and kidney disease [56]. Among respondents aged 21 to 30, 9 out of 52 reported experiencing affect concentration caused by the construction noise occurs near to their residential area, both 14 respondents out of 52 said that construction noise affects their sleep and Interferes work or study. The majority of the respondents said that they feel sleeping problem and suffered from Interferes work or study whenever noise pollution happens. For the age range 41-50 years old, 6 out of 32 participants agreed that they suffered from stress. It indicates that as age increases, individuals can better tolerate construction noise.

Table 3: Pearson Chi-Square Analysis of the Association between age and effect of construction on health

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	16.766[a]	16	.401
Likelihood Ratio	17.083	16	.380
Linear-by-Linear Association	1.485	1	.223
N of Valid Cases	150		
a. 13 cells (52.0%) have expected count less than 5. The minimum expected count is 1.25.			

Since P = 0.401 > 0.05, so our hypothesis is statistically insignificant at 5% level of significance. Thus, we may conclude that the variable of Age and effect of construction on health are independent.

Table 4: Community perceived disruptions caused by urban construction activities (n=150)

Disruption Type	Frequency	Percentages (%)
Air pollution	140	93.3%
Noise pollution	143	95.3%
Water pollution	60	40%
Loss of vegetation	132	88%
Biodiversity loss	110	73.3%
Heat increase	128	85.3%
Drainage issues	85	56.6%
Waste mismanagement	92	61.3%
Soil degradation	20	13%
Traffic congestion	115	76.6%
Blockage of pedestrian walkways	123	82%

Air pollution by construction activities and impact on community health

Table 5. Frequency of poor air quality due to construction activities

Period of time	frequency	Percentages (%)
Every day	72	48.0
Several times a week	32	21.3
Once a week	6	4.0
Occasionally	25	16.7
Rarely	15	10.0

Table 5 highlight the frequency of poor air quality due to construction activities. In our study 48% of respondents notice poor air quality every day where 21.3% participants stated that they are seen that several times a week. 16.7% replied occasionally where 4% once a week and almost 10% told that rarely. This shows that the air quality in Rajshahi city is decreasing day by day. Its level is comparatively higher around mega project.

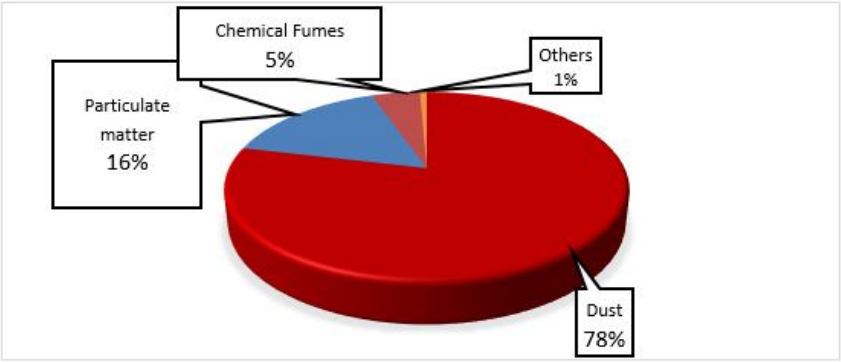


Figure 8: Types of air pollution

Source of air pollution illustrate in figure 8, Most air pollution occurs due to dust (78%). 16% air polluted by particulate matter where only 5% by chemical fumes. The most pollution is caused by digging up soil and placing sand along the roadside. The construction sector is a major contributor to air pollution across various countries [57,58,59]

Table 6: Analysis of variance (ANOVA) test of air pollution related illness in different overall air quality rate.

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	26.025	3	8.675	6.079	.001
Within Groups	208.348	146	1.427		
Total	234.373	149			

We see that the calculated value of F is 6.079 and the p-value is 0.001 which is less than 0.05. A value of $P < 0.05$ was considered as statistically significant in this analysis. Finally, we said that air pollution related illness is different among rate of overall air quality in Rajshahi and overall air quality has impact on air pollution related illness.

Table 7 indicates that 11 out of 150 respondents were aged between 16 to 20 years old. Four participants aged 16 to 20 years acknowledged that construction air pollution led to asthma symptoms, while 3 respondents reported respiratory issue due to air pollution,3 individuals aged between 16 1nd 20 years stated that there is no health effect even when construction activities going on. Of the 11 respondents within this age group,1 experienced cause eye irritation despite their youth. Among respondents

aged 21 to 30,23 out of 52 respondents reported experiencing respiratory issue caused by construction air pollution occurs near to their residential area,10 respondents out of 52 said that construction air pollution caused eye irritation where 11 respondents stated asthma symptoms. The majority of the respondents said that they feel respiratory issue and suffered from asthma symptoms whenever air pollution happens. Air pollution has numerous health effects on the worldwide populace, with approximately 91% of individuals globally impacted by air pollution, based on WHO standards [60]. For the age range 41-50 years old, 12 out of 32 participants agreed that they suffered from respiratory issue like coughing. It indicates that as age increases, individuals can better tolerate construction air pollution.

Table 7: The Age of Respondents Vs the Effect of Air Pollution on health

			Air pollution related health issue				Total
			Respiratory issue (coughing)	Eye irritation	Asthma symptoms	No health effect	
Age Category	16-20 years	Count	3	1	4	3	11
	21-30 ears	Count	23	10	11	8	52
	31-40 years	Count	14	4	6	18	42
	41-50 years	Count	12	1	7	12	32
	50+ years	Count	4	3	4	2	13
Total		Count	56	19	32	43	150

Table 8: Analysis of variance (ANOVA) test of the impact of construction overall physical health in different occupation

Source of variation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	16.176	5	3.235	3.594	.004
Within Groups	129.617	144	.900		
Total	145.793	149			

We see that the calculated value of F is 3.594 and the p-value is 0.004 which is less than 0.05. A value of $P < 0.05$ was considered as statistically significant in this analysis. Finally, we said that the impact of construction overall physical health on a scale of 1 to 10 is different among Occupation. We also said that occupation has effect on overall physical health.

Most vulnerable groups of people in urban construction related disturbance

Correlation between age and Perceived impacts on Physical Health by urban construction activities.

Variables	r	p-value	N	Significance
Age × Perceived Impact on Health	.923	.001	150	Significant at 0.01 level

center51435000We see that the calculated value of r is 0.923 and the p-value is 0.001 which is less than 0.01. A value of $P < 0.01$ was considered as statistically significant in this analysis. Finally, we said that Age is associated with the perceived impact of urban construction activities on physical health.

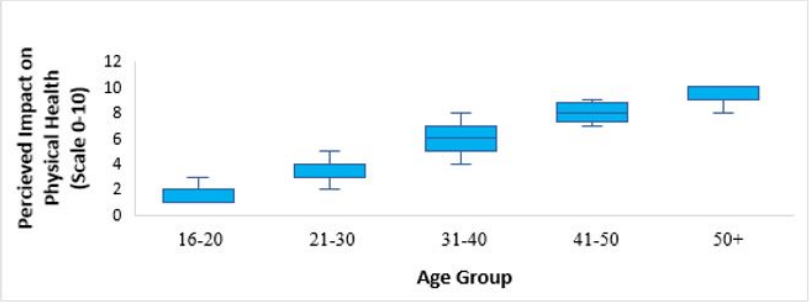


Figure 9: Perceived Physical Health Impact of Urban Construction by Age Group

Figure 9 illustrates perceived physical health impact of urban construction by age group in Rajshahi City. According to Perceived Impact on Physical Health (Scale 0–10) a higher value shows a greater negative impact on physical health due to urban construction activities. In this box plot we can see that age groups categorized into five groups 16–20, 21–30, 31–40, 41–50, and 50+. This box plot indicates that there's a clear upward trend in perceived health impact as age increases. This suggests that older age groups are more vulnerable to the physical health impacts of urban construction. The 50+ age group report the highest perceived impact, with a score closely distributed around 9 to 10. This indicates both high sensitivity and agreement within this group regarding the impact. The 41–50 and 31–40 groups also report relatively high impacts, with medians around 8.5 and 6, respectively this called moderately vulnerable groups. 16–20 and 21–30 age groups show lower median impacts (around 2 and 4), with wider variation. This low impact due to stronger immunity, lower pre-existing conditions, or less time spent in construction-affected environments. Urban construction activities (e.g., noise, dust, traffic, vibration) disproportionately affect older populations in Rajshahi City. we easily identified that the elderly (50+) as the most vulnerable group, followed by middle-aged adults.

Expected risks by age group:

Age	16-20	21-30	31-40	41-50	50+
Prevalence	1.25%	2.84%	5.74%	9.35%	16.55%

This table presents expected health risks (prevalence) by age group, sourced from [61]. Age group 50+ has the highest prevalence (16.55%) more than 13 times higher than the 16–20 age group. Even the middle-aged groups (41–50) face notable risks (9.35%). Health risks steadily rise with age, possibly due to declining immunity, pre-existing conditions, or increased sensitivity to environmental changes e.g., dust, noise, air pollution from construction. Based on this data, the elderly population (50+) are the most vulnerable group to the health impacts of urban construction. This table indicates that age is a key determinant of vulnerability, with older adults being at significantly higher risk of adverse health effects from urban construction.

Psychological impact by urban construction activities in Rajshahi city

This table 9 shows Pearson correlation coefficients between different psychological stress scale (PSS) items. The Perceived Stress Scale (PSS) is a widely recognized and validated tool for assessing perceived stress levels in individuals. The PSS-10 is composed of both positively and negatively worded items. PSS (1-7) shows negative item and (8-10) shows positive item. The significant correlations (mostly at the 0.01 level) indicate that urban construction activities are interconnected with multiple aspects of psychological stress among the urban community in Rajshahi. These stress indicators include anxiety, frustration, helplessness, lack of control, or exposure to noise, dust, and disruption—all likely intensified by construction work. The clustering of high correlations among items like PSS 1–5 suggests that these Significant health concerns reflect core psychological reactions to urban environmental changes. This analysis statistically significant and correlate with each PSS item.

Table 9: Correlation between different perceived stress scale

ITEM	PSS 1	PSS 2	PSS 3	PSS 4	PSS 5	PSS 6	PSS 7	PSS 8	PSS 9	PSS 10
PSS 1	1									
PSS 2	.662**	1								
PSS 3	.519**	.559**	1							
PSS 4	.560**	.524**	.443**	1						
PSS 5	.618**	.540**	.494**	.538**	1					
PSS 6	0.133	.299**	.241**	.266**	.202*	1				
PSS 7	.455**	.527**	.421**	.525**	.446**	.242**	1			
PSS 8	.484**	.382**	.330**	.282**	.392**	0.125	.280**	1		
PSS 9	.565**	.339**	.386**	.420**	.489**	0.095	.358**	.559**	1	
PSS 10	.365**	.167*	.187*	.312**	.345**	0.101	.249**	.347**	.584**	1
**. Correlation is significant at the 0.01 level (2-tailed).										
*. Correlation is significant at the 0.05 level (2-tailed).										

This table 10 shows the association between stress level and gender. We see that the calculated value of $\chi^2 = 6.204$ and the p-value is 0.045 which is less than 0.05. A value of $P < 0.05$ was considered as statistically significant in this analysis. This result is statistically significant at the 0.05 level, indicating a significant association between gender and stress level. This table indicates that stress levels vary by gender, which reflect how urban construction disproportionately affecting certain groups within the urban community. Males are more likely to report higher stress levels (13% high stress where 10.5% for females), and a larger portion of males fall into the moderate stress category (61.8%). On the other hand, Females show a higher percentage of low stress (52.6%), but this may be influenced by the small sample size (n=19). Moderate Stress is the most common level across both genders (especially males), making it the dominant stress response to urban construction activities. Finally, we found that males appear to be the most vulnerable group in terms of psychological stress caused by urban construction in Rajshahi city. Men, who more frequently working in or around construction zones (e.g., as laborers, rickshaw pullers, shopkeepers, or residents), are experiencing higher stress levels.

Table 10: Association between stress level and gender

Stress Level	Male (n = 131)	Female (n = 19)	Total (n = 150)
Low Stress	33 (25.2%)	10 (52.6%)	43 (28.7%)
Moderate Stress	81 (61.8%)	7 (36.8%)	88 (58.7%)
High Stress	17 (13.0%)	2 (10.5%)	19 (12.7%)
$\chi^2 = 6.204$, df = 2, p = .045			

Figure 10 indicates the main reason for psychological stress by urban construction activities. Majority of participants reported that noise pollution and dust or air pollution was the main reason for psychological stress. Almost 8% respondents stated that traffic congestion and disruption of daily routine were part of their psychological stress. Individuals who experience annoyance might undergo various adverse physical and psychological responses, including fatigue, stomach pain, anger, frustration, and worry. Health is characterized as a condition of not just physical but also mental and social wellness [62]. Primarily, construc-

tion workers and laborers are compelled to finish tasks even in poor weather conditions, working longer hours than usual in hot climates, dealing with loud machinery at construction sites, and facing dust on-site, all of which impact their mental well-being [33]. Changes in sleep patterns have been associated with harmful psychological issues such as depression and anxiety [53]. The primary factor behind cardiovascular disease is stress, which is generated by noise pollution [55].

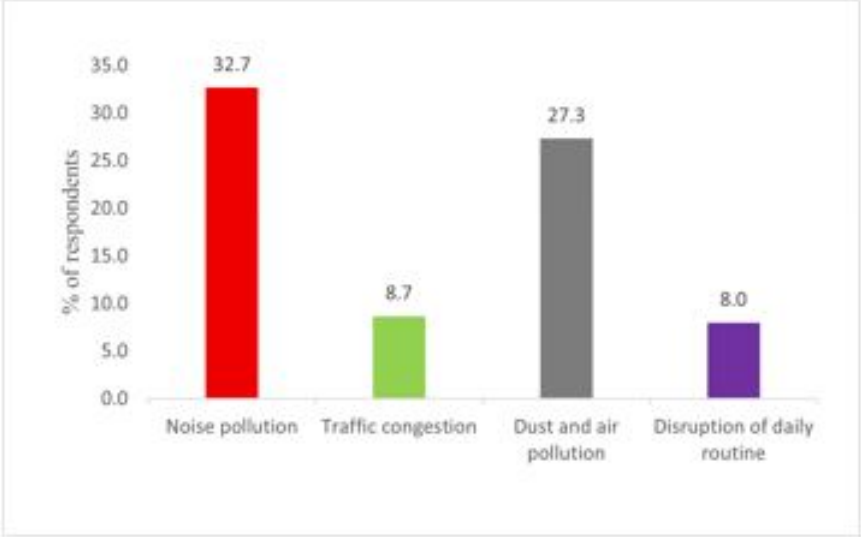


Figure 10: Reason for psychological Stress

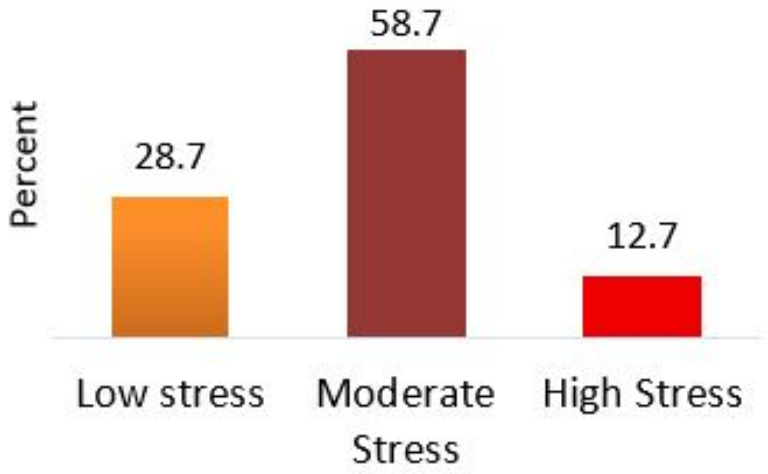


Figure 11: Perceived level of psychological stress

This figure 11 presents critical insights into the perceived level of psychological stress experienced by residents. The majority of respondents (58.7%) stated experiencing moderate levels of stress due to ongoing urban construction. About 28.7% of respondents perceived low levels of stress. This group include those residents who live slightly further from major construction area or have adapted strategies to the disturbances. Working outdoors in the sun and facing high noise levels puts construction workers to significant stress [63]. A significant minority (12.7%) experience high psychological stress. Stress is a significant issue that leads to cardiovascular disease, and one of the contributing factors to stress is noise pollution[64].These individuals are likely the most vulnerable, due to their vicinity to heavyconstruction sites, health situations, lack of competitive mechanisms, or poor housing conditions. This figure underline that while urban development is necessary, its psychological toll on residents must not be overlooked.

Table 11: Analysis of variance (ANOVA) test of the impact of overall mental health in different work place

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	85.408	3	28.469	61.824	.001
Within Groups	67.232	146	.460		
Total	152.640	149			

We see that the calculated value of F is 61.824 and the p-value is 0.001 which is less than 0.05. A value of $P < 0.05$ was considered as statistically significant in this analysis. Finally, we said that the impact of construction overall mental health on a scale of 1 to 10 is different among noise level at work place.

Conclusion and Recommendations

Construction activities are the important source which responsible to destroy environment and impact on urban community health. Our study aimed to find out the impact of urban construction activities on urban community health in Rajshahi city, to evaluate which groups of people are most vulnerable and to assess psychological impact of urban construction activities in Rajshahi city. Noise pollution is one of the problems of Rajshahi citizens. The noise pollution resulting from massive construction projects such as the flyover along with residential texture is one of the most important environmental pollutants in the urban environment which in various dimensions threatens human health. During the study period, maximum and minimum noise level were recorded as 94.88 and 74.00 dB in Rajshahi city in the month of February. The intensity of the noise in the city's central locations (85-93) dB. Especially in the city center, east and western parts of Rajshahi city where several mega projects are ongoing, the noise intensity is highest, with the maximum level reaching 93 dB in contrast. The primary four sources of noise pollution identified by the respondents included drilling or hammering, machinery operation, huge number of respondents agreed that operating heavy machinery causes mostly noise pollution at construction sites. Majority of the participants stated that the most noise was generated in the afternoon from construction projects. This signifies that the noise pollution significantly impacts the well-being and living conditions of residents. The majority of the respondents said that they feel sleeping problem and suffered from Interferes work or study whenever noise pollution happens. The primary factor behind cardiovascular disease is stress, and this stress has been caused by noise pollution. Our findings suggest that while majority respondents notice poor air quality every day. Our study finds that the air quality in Rajshahi city is decreasing day by day. Most air pollution occurs due to dust. The majority of the respondents said that they feel respiratory issue and suffered from asthma symptoms whenever air pollution happens. In our study we find out the impact of construction overall physical health is different among occupation. Our study suggests that older age groups are more vulnerable to the physical health impacts of urban construction. The 50+ age group report the highest perceived impact, with a score closely distributed around 9 to 10. we easily identified that the elderly (50+) as the most vulnerable group, followed by middle-aged adults. there were significant association between gender and stress level. we found that males appear to be the most vulnerable group in terms of psychological stress caused by urban construction in Rajshahi city because they frequently working in or around construction zones (e.g., as laborers, rickshaw pullers, shopkeepers, or residents), are experiencing higher stress levels. Health risks steadily rise with age. Based on this data, the elderly population (50+) are the most vulnerable group to the health impacts of urban construction. Majority of participants reported that noise pollution and dust or air pollution was the main reason for psychological stress. The majority of respondents stated experiencing moderate levels of mental stress due to ongoing urban construction. Rajshahi City Corporation (RCC) and Rajshahi Development Authority (RDA) should work jointly to regulate and monitor the construction sites across the city to ensure environmental protection and public health safety. Effective enforcement of dust control, noise reduction, and waste management is crucial for pollution control and safeguarding community health. In addition, providing training to construction workers on proper handling of construction materials and site management can reduce dust and other particulate emissions, which could serve as an effective measure to mitigate negative impacts of construction projects. This study was mainly carried

out by community perceptions about the impacts of construction activities on community health. However, it did not include direct medical assessments such as heart rate, blood pressure, or respiratory measurements to evaluate actual health effects on urban community. This remains a key limitation of that study, and future research should include both perception-based surveys and clinical measurements to provide a more accurate understanding of construction activities related to health impacts. Identifying the most effective interventions to minimize the adverse effects of construction activities on community health should be a key priority for future research.

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