

# The Relationship between Socio-demographic Factors and Noise Sensitivity among City Dwellers in Rajshahi

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## Abstract

Noise pollution is a growing environmental concern in urban areas, affecting psychological well-being and public health. While previous research has explored noise levels, limited studies have examined their relationship with socio-demographic characteristics and noise sensitivity in developing cities like Rajshahi, Bangladesh. This study aimed to investigate the relationship between socio-demographic factors and noise sensitivity among city dwellers in Rajshahi. A cross-sectional study was conducted with 817 participants recruited using a convenience sampling technique between December 2023 and May 2024. Noise sensitivity was measured using the Noise Sensitivity Scale (NSS), and noise annoyance was assessed using the ICBEN noise annoyance questionnaire. Descriptive statistics, chi-square tests, and correlation analyses were performed using SPSS (Version 26.0), and a p-value < .05 was considered statistically significant. Findings revealed that age, marital status, occupation, socioeconomic status, sleep duration, noise annoyance, and long-term disease were significantly associated with noise sensitivity ( $p < .05$ ). Younger individuals, students, and those experiencing higher noise annoyance exhibited greater noise sensitivity. However, gender, educational qualification, income level, residence type, and duration of city living were not significantly related to noise sensitivity ( $p > .05$ ). The study shows the role of socio-demographic and behavioral factors in noise perception, with younger individuals, students, and those with high noise annoyance being

the most affected. These findings emphasize the need for urban noise regulation policies and public awareness initiatives to mitigate noise-related health effects. Future research should explore longitudinal designs and objective noise measurement techniques to strengthen causal interpretations.

**Keywords:** noise pollution, noise sensitivity, noise annoyance, socio-demographic factors, urban environment, Bangladesh

## Introduction

Noise pollution is a universal environmental stressor in urban areas, significantly impacting individuals' quality of life and well-being (Basner & McGuire, 2018). With increasing urbanization, city dwellers are frequently exposed to high levels of environmental noise, originating from traffic, construction, industries, and social activities (WHO, 2018). Rajshahi, one of Bangladesh's major cities, is no exception, experiencing rising noise levels due to rapid urban expansion and increased vehicular movement. The World Health Organization (WHO) has recognized noise pollution as a public health concern, linking prolonged exposure to adverse effects such as sleep disturbances, cardiovascular diseases, and mental health issues (Munzel et al., 2018; Park et al., 2017). However, individuals respond differently to noise exposure based on personal attributes such as noise sensitivity and perceived noise annoyance (Fyhri & Klæboe, 2018).

Noise sensitivity is a stable personality trait that influences how individuals perceive and react to noise, irrespective of its actual intensity (Shepherd et al., 2010; Stansfeld et al., 2021). In contrast, noise annoyance refers to the subjective discomfort or distress caused by unwanted noise, which varies depending on personal and environmental factors. Research suggests that socio-demographic characteristics such as age, gender, education, and occupation play a crucial role in shaping individuals' sensitivity and annoyance to noise (Janssen et al., 2011). Understanding these relationships is essential for developing effective noise management strategies and public health policies tailored to diverse populations.

Given the increasing noise pollution in Rajshahi (Sarker et al., 2023), this study aims to explore the relationship between socio-demographic characteristics and noise sensitivity among

city dwellers. By identifying key demographic predictors of noise perception, the study seeks to provide insights into targeted interventions to mitigate the adverse effects of noise pollution in urban settings.

## **Literature Review**

Noise pollution has become a pressing environmental issue in urban settings, adversely affecting public health and well-being (Basner & McGuire, 2018). Chronic exposure to environmental noise has been linked to cardiovascular diseases, sleep disturbances, cognitive impairments, cardiovascular disease, and increased psychological distress (Thompson et al., 2022; Munzel et al., 2018; Basner & McGuire, 2018; Van Kempen et al., 2018; Park et al., 2017). The World Health Organization (WHO) has emphasized that prolonged exposure to noise levels exceeding recommended thresholds can contribute to stress, reduced quality of life (Han, 2020), and mental health issues such as anxiety and depression (WHO, 2018; Basner & McGuire, 2018). Urban residents, particularly those in densely populated areas, are more vulnerable to these effects due to continuous exposure to high noise levels from transportation, industries, and construction activities.

Noise sensitivity is a stable individual trait that influences how people perceive and react to noise, regardless of its actual intensity (Shepherd et al., 2010). It is considered an essential psychological factor that moderates the effects of noise exposure on health outcomes (Fyhri & Klæboe, 2018). Studies show that people who are highly sensitive to noise are more likely to be irritated (Riedy et al., 2021; Sarker et al., 2024), stressed (Basner & McGuire, 2018; Thompson et al., 2022), and have trouble sleeping (Münzel et al., 2021; Riedy et al., 2021) than people who are less susceptible. Furthermore, research indicates that noise sensitivity is associated with increased physiological responses, including elevated cortisol levels and heightened cardiovascular reactivity. (Münzel et al., 2018; Van Kempen et al., 2018)

Noise annoyance is a widely studied negative reaction to environmental noise and is influenced by both personal and contextual factors (Janssen et al., 2011). It is defined as a subjective feeling of discomfort or distress caused by unwanted noise, often leading to negative psychological and physiological effects (Öhrström et al., 2006). Factors such as noise characteristics, individual noise sensitivity, and environmental conditions contribute to the

degree of annoyance experienced by individuals (Guski et al., 2017). Research has shown that noise annoyance can lead to impaired concentration, reduced work productivity, and increased risk of developing mental health disorders such as depression and anxiety (Beutel et al., 2016).

Several socio-demographic characteristics, including age, gender, education level, and occupation, influence noise sensitivity and annoyance responses. Studies suggest that older adults generally report higher levels of noise sensitivity and annoyance compared to younger individuals, possibly due to increased susceptibility to environmental stressors (Öhrström et al., 2006). Gender differences have also been observed, with females often exhibiting greater noise sensitivity and reporting higher annoyance levels than males (Shepherd et al., 2010). Additionally, individuals with higher educational backgrounds tend to have increased awareness of noise-related health risks and may report higher annoyance levels. Occupational exposure to noise is another critical factor, as individuals working in high-noise environments, such as industrial or transportation sectors, are more likely to develop noise-related stress and health problems.

### **Research Gaps and Rationale of the Study**

Although previous studies have extensively examined noise pollution levels, limited research has focused on the specific socio-demographic determinants of noise perception in the context of developing cities like Rajshahi. Understanding how various factors influence noise sensitivity in Bangladeshi city dwellers is essential for designing effective noise management policies. This study aims to bridge this gap by analyzing the relationship between socio-demographic characteristics and noise sensitivity among residents of Rajshahi, providing insights for future urban planning and public health interventions.

### **Main Objective**

To examine the relationship between socio-demographic characteristics and noise sensitivity, among city dwellers in Rajshahi.

### **Specific Objectives**

1. To assess the levels of noise sensitivity among city dwellers in Rajshahi.

2. To explore the association between socio-demographic characteristics (e.g., age, gender, education, and occupation) and noise sensitivity.

### **Method**

This study employed a cross-sectional research design to examine the relationship between socio-demographic characteristics and noise sensitivity among city dwellers in Rajshahi. A convenience sampling technique was used to recruit participants from various locations in Rajshahi, including residential, commercial, and educational areas.

Participants were included in the study if they were residents of Rajshahi City for at least one year, were aged 18 years or older, and provided informed consent to participate. On the other hand, participants were excluded if they had hearing impairments or neurological disorders that could affect their perception of noise.

The sample size was calculated by using the following method for the unknown population formulae in survey research (Cochran, 1977).  $n = \frac{Z^2 \times p \times q}{d^2} = \frac{1.96^2 \times .5 \times .5}{.05^2} = 384$ . Here,  $n$  = minimum sample size,  $Z$  = confidence level of z-statistic (look up a z-table based on your desired confidence level) = 1.96,  $p$  = estimated proportion of the population with the characteristic of interest = 0.5 (unknown),  $q = 1-p = 1-0.5 = 0.5$ , and  $d$  = desired precision (margin of error) or allowable error in estimation or confidence interval = 0.05. Therefore, for exploring the sample size for survey-type research, a total sample of 384 is recommended. This present study's sample size ( $n = 817$ ) fulfilled this criterion. However, this study's sample size exceeded the requirement well.

The Bangla Version of the Noise Sensitivity Scale Short Form (NSS-SF-BF) was used to measure noise sensitivity. This scale was first developed by Weinstein in 1978 and later shortened by Benfield et al. (2012). It was then adapted and used by the authors of this study (Sarker et al., 2024). The scale consists of 5 items, rated on a 6-point Likert-type scale ranging from 1 (strongly disagree) to 6 (strongly agree). The score ranged from 5 to 30. Higher scores indicate greater noise sensitivity. The NSS has been widely used in environmental psychology and has demonstrated high reliability (Cronbach's  $\alpha = 0.80-0.90$ ) in previous studies (Shepherd et al., 2010). In this study, internal consistency was found,  $\alpha = .74$ .

Noise annoyance was measured using the International Commission on Biological Effects of Noise (ICBEN) questionnaire, a widely accepted tool for assessing noise annoyance (Guski et al., 2017). The ICBEN questionnaire includes a single-item annoyance scale rated on a 5-point scale (1 = not at all annoyed to 5 = extremely annoyed). Based on the recommended single item from an extensive literature review, this study created a total of five items. Total scores ranged from 5 to 25. A higher score indicates more noise annoyance. This method has been validated in multiple noise studies and is recommended by the World Health Organization (WHO, 2018) for assessing subjective noise annoyance. In this study, internal consistency was found,  $\alpha = .73$ .

This study was conducted following ethical guidelines established by the Declaration of Helsinki (2013). Ethical approval was obtained from the Institute of Biological Sciences (IBSc), University of Rajshahi (Reference No.: 455(12)/320/IAMEBBC/IBSc; Date: 14/09/2023) before data collection. Participants were informed about the study's purpose, assured of their confidentiality, and provided informed consent before participation. They were also given the right to withdraw from the study at any time without penalty.

Data collection took place from December 2023 to May 2024 in various urban locations in Rajshahi. Trained research assistants approached potential participants and provided an overview of the study. Participants who agreed to participate signed a written consent form before completing a self-administered questionnaire. Each questionnaire took approximately 10–15 minutes to complete. To ensure data quality, questionnaires were checked for completeness before submission.

Data were analyzed using SPSS (Version 26.0). Frequency, percentage, mean, standard deviation (SD), chi-square value, and p-value were calculated to summarize socio-demographic data and noise sensitivity levels. A significance level of  $p < .05$  was considered statistically significant.

## Results

Table 1 presents the relationship between socio-demographic factors and the prevalence of noise sensitivity among the inhabitants of Rajshahi metropolitan city. Noise sensitivity is

categorized into three levels: low ( $n_1 = 151$ ), medium ( $n_2 = 496$ ), and high ( $n_3 = 170$ ). The table includes variables such as age, gender, marital status, educational qualification, occupation, income level, socioeconomic status, duration of city residence, and residence type. The chi-square ( $\chi^2$ ) test was used to determine the statistical significance of associations, with a significance threshold of  $p < .05$ .

Participants were divided into three age groups: young age (57.4%), young adulthood (26.7%), and middle adulthood (15.9%). The highest proportion of participants with high noise sensitivity was found in the young age group (12.36%), while middle-aged adults (2.20%) exhibited the lowest high noise sensitivity scores. The chi-square test ( $\chi^2 = 13.37$ ,  $p = .003$ ) revealed a significant association between age and noise sensitivity, suggesting that younger individuals are more likely to experience higher noise sensitivity.

Noise sensitivity levels were nearly similar between males (48.1%) and females (51.89%), with females exhibiting slightly higher mean noise sensitivity scores ( $M = 24.14$ ,  $SD = 2.89$ ) compared to males ( $M = 23.97$ ,  $SD = 3.11$ ). However, the chi-square analysis did not reveal a significant relationship between gender and noise sensitivity ( $\chi^2 = 1.57$ ,  $p = .45$ ), indicating that noise sensitivity does not significantly differ by gender.

Unmarried participants (55.55%) reported higher noise sensitivity scores ( $M = 24.26$ ,  $SD = 2.95$ ) compared to married participants ( $M = 23.80$ ,  $SD = 3.04$ ). The chi-square test showed a significant relationship between marital status and noise sensitivity ( $\chi^2 = 6.37$ ,  $p = .04$ ), indicating that unmarried individuals tend to be more noise-sensitive than married individuals.

Participants with higher education (honors and master's degrees) reported higher noise sensitivity levels, while those with primary and secondary education had lower noise sensitivity scores. However, the chi-square test ( $\chi^2 = 16.03$ ,  $p = .09$ ) indicated that the relationship between educational qualification and noise sensitivity was not statistically significant.

Among different occupations, students (60.7%) exhibited the highest prevalence of noise sensitivity, with 13.21% in the high noise sensitivity group. In contrast, drivers/rickshaw pullers (6.24%) showed the lowest mean noise sensitivity score ( $M = 22.33$ ,  $SD = 3.38$ ). The chi-square test ( $\chi^2 = 25.31$ ,  $p = .005$ ) indicated a statistically significant relationship between occupation and

noise sensitivity, suggesting that students experience higher noise sensitivity than other occupational groups.

Participants were grouped into five income levels, with most participants (60.09%) earning between 5,001 and 10,000 BDT per month. The highest mean noise sensitivity score ( $M = 24.21$ ,  $SD = 3.17$ ) was observed among those earning 40,001 to 100,000 BDT. However, the chi-square test ( $\chi^2 = 9.61$ ,  $p = .29$ ) showed no significant association between income level and noise sensitivity.

The majority of participants belonged to the middle class (84.45%), followed by the lower class (13.46%) and higher class (2.08%). The highest mean noise sensitivity score ( $M = 24.15$ ,  $SD = 2.91$ ) was recorded among middle-class participants. The chi-square test ( $\chi^2 = 10.17$ ,  $p = .03$ ) showed a significant association between socio-economic status and noise sensitivity, indicating that individuals from different socioeconomic backgrounds experience noise sensitivity differently.

Participants were categorized based on how long they had lived in Rajshahi city. The highest mean noise sensitivity score ( $M = 24.31$ ,  $SD = 3.16$ ) was observed among those who had lived in the city for 11 to 20 years. However, the chi-square test ( $\chi^2 = 7.96$ ,  $p = .43$ ) indicated no significant association between living duration and noise sensitivity.

Participants were classified based on their residence type: home (61.32%), college hostel/university hall (11.02%), and those living in a mess (27.66%). The highest mean noise sensitivity score ( $M = 24.54$ ,  $SD = 2.83$ ) was observed among those living in mess accommodations, whereas homes had slightly lower noise sensitivity scores ( $M = 23.91$ ,  $SD = 3.02$ ). However, the chi-square test ( $\chi^2 = 7.35$ ,  $p = .12$ ) indicated no significant association between residence type and noise sensitivity.

For the sleep duration, most participants (61.93%) reported sleeping between 6 to 8 hours, while 16.89% slept 4 to 5 hours, and 21.17% slept 9 to 10 hours. Participants who slept 4 to 5 hours exhibited the highest mean noise sensitivity score ( $M = 24.38$ ,  $SD = 3.21$ ), while those who slept 6 to 8 hours had a slightly lower sensitivity ( $M = 23.86$ ,  $SD = 2.94$ ). The chi-square test revealed a significant association between sleep duration and noise sensitivity ( $\chi^2 = 10.80$ ,  $p = .029$ ), indicating that sleep duration may influence noise sensitivity.

Participants with long-term diseases (24.11%) also exhibited slightly lower noise sensitivity ( $M = 23.87$ ,  $SD = 3.37$ ) compared to those without chronic illnesses ( $M = 24.14$ ,  $SD = 2.87$ ). The chi-square test indicated a significant association between long-term disease and noise sensitivity ( $\chi^2 = 14.42$ ,  $p = .001$ ).

Lastly, noise annoyance levels were categorized into low, medium, and high, with most participants (66.80%) experiencing medium annoyance. Those with high noise annoyance showed the highest mean noise sensitivity ( $M = 25.76$ ,  $SD = 2.69$ ), while those with low noise annoyance had the lowest ( $M = 22.44$ ,  $SD = 3.24$ ). A statistically significant association was observed between noise annoyance and noise sensitivity ( $\chi^2 = 79.01$ ,  $p < .001$ ), further supporting the link between annoyance and sensitivity.

**Table 1**

*The Relationship Between Socio-Demographic Factors and The Prevalence of Noise Sensitivity Among The Inhabitants of Rajshahi Metropolitan City (N=817)*

Variables	Number (%)	Noise sensitivity (n= 817)			Noise sensitivity M (SD)	Chi-square value (p-value)
		Low (n1 =151) n (%)	Medium (n2 = 496) n (%)	High (n3 = 170) n (%)		
<b>Age</b>						
Young age	469 (57.40)	73 (8.93)	295 (36.10)	101 (12.36)	24.23(2.96)	13.37 (.003)
Young adulthood	218 (26.68)	39 (4.77)	128 (15.66)	51 (6.24)	24.25(2.78)	
Middle adulthood	130 (15.91)	39 (4.77)	73 (8.93)	18 (2.20)	23.10 (3.29)	
<b>Gender</b>						
Male	393 (48.10)	79 (9.66)	231 (28.27)	83 (10.15)	23.97 (3.11)	1.57 (0.45)
Female	424 (51.89)	72 (4.81)	265 (32.43)	87 (10.64)	24.14 (2.89)	
<b>Marital status</b>						
Unmarried	454 (55.55)	70 (8.56)	286 (35.00)	98 (11.99)	24.26 (2.95)	6.37 (0.04)
Married	363 (44.44)	81 (9.91)	210 (25.70)	72 (8.81)	23.80 (3.04)	
<b>Educational Qualification</b>						
Primary	44 (5.38)	14 (1.71)	25 (3.05)	5 (0.61)	22.75 (3.07)	16.03 (0.09)
Secondary	58 (7.09)	14 (1.71)	36 (4.40)	8 (0.97)	23.21 (3.01)	
Higher Secondary	78 (9.55)	19 (2.32)	41(5.02)	18 (2.20)	23.86 (3.11)	
Honor's	415 (50.79)	67 (8.20)	264 (32.31)	84 (10.28)	24.13 (2.87)	
Master	213 (26.07)	35 (4.28)	126 (15.42)	52 (6.36)	24.47 (3.04)	
MPhil/PhD	9 (1.10)	2 (0.24)	4 (0.48)	3 (0.36)	24.33 (3.74)	
<b>Occupations</b>						
Teachers	50 (6.11)	10 (1.22)	27 (3.30)	13 (1.59)	24.22 (3.04)	25.31 (.005)
Others services	59 (7.22)	10 (1.22)	34 (4.16)	15 (1.83)	24.42 (2.82)	
Street business	73 (8.93)	15 (1.83)	45 (5.50)	13 (1.59)	23.67 (3.11)	
Students	496 (60.70)	75 (9.18)	313 (38.31)	108 (13.21)	24.33 (2.92)	

Drivers/rickshaw puller	51 (6.24)	21 (2.57)	24 (2.93)	6 (0.73)	22.33 (3.38)	
House waives	88 (10.77)	20 (2.44)	53 (6.48)	15 (1.83)	23.52 (2.81)	
<b>Income levels (tk.)</b>						
0 to 5000	112 (13.70)	24 (2.93)	64 (7.83)	24 (2.93)	23.98 (2.94)	9.61 (0.29)
5001 to 10000	491 (60.09)	77 (9.42)	311 (38.06)	103 (12.60)	24.19 (2.93)	
10001 to 20000	98 (11.99)	26 (3.18)	52 (6.36)	20 (2.44)	23.62 (3.14)	
20001 to 40000	63 (7.71)	13 (1.59)	40 (4.89)	10 (1.22)	23.68 (3.21)	
40001 to 100000	53 (6.48)	11 (1.34)	29 (3.54)	13 (1.59)	24.21 (3.17)	
<b>SES</b>						
Lower class	110 (13.46)	31 (3.79)	56 (6.85)	23 (2.81)	23.51 (3.30)	10.17 (0.03)
Middle class	690 (84.45)	116 (14.19)	432 (52.87)	142 (17.38)	24.15 (2.91)	
Higher class	17 (2.08)	4 (0.48)	8 (0.97)	5 (0.61)	24.00 (3.92)	
<b>Living duration in city</b>						
1 to 5 years	265 (32.43)	42 (5.14)	163 (19.95)	60 (7.34)	24.22 (2.97)	7.96 (0.43)
6 to 10 years	241 (29.49)	42 (5.14)	151 (18.48)	48 (5.87)	24.10 (2.92)	
11 to 20 years	108 (13.21)	23 (2.81)	58 (7.09)	27 (3.30)	24.31 (3.16)	
21 to 30 years	125 (15.29)	26 (3.18)	74 (9.05)	25 (3.05)	23.92 (3.02)	
31 and above years	78 (9.54)	18 (2.20)	50 (6.12)	10 (1.22)	23.44 (3.04)	
<b>Residence type</b>						
Home	501 (61.32)	102 (12.48)	300 (36.71)	99 (12.11)	23.91 (3.02)	7.35 (0.12)
Hall/hostel	90 (11.02)	20 (2.44)	53 (6.48)	17 (2.08)	23.66 (3.13)	
Mess	226 (27.66)	29 (3.55)	143 (17.50)	54 (6.60)	24.54 (2.83)	
<b>Sleep duration</b>						
4 and 5 hours	138 (16.89)	23 (2.81)	75 (9.17)	40 (4.89)	24.38 (3.21)	10.80 (.029)
6 to 8 hours	506 (61.93)	100 (12.23)	318 (38.92)	88 (10.77)	23.86 (2.94)	
9 to 10 hours	173 (21.17)	28 (3.42)	103 (12.60)	42 (5.14)	24.39 (2.94)	
<b>Long term disease</b>						
Yes	197 (24.11)	51 (6.24)	98 (11.99)	48 (5.87)	23.87 (3.37)	14.42 (.001)
No	620 (75.88)	100 (12.23)	398 (48.71)	122 (14.93)	24.14 (2.87)	
<b>Noise annoyance</b>						
Low	138 (16.90)	51 (6.20)	73 (8.90)	14 (1.70)	22.44 (3.24)	79.01 (.000)
Medium	546 (66.80)	90 (11.00)	356 (43.60)	100 (12.20)	24.05 (2.77)	
High	133 (16.30)	10 (1.20)	67 (8.20)	56 (6.90)	25.76 (2.69)	

Note.: n = sample size, M = Mean, SD = Standard deviation, SES = Socio-economic status

Table 2 presents the Spearman’s Rho correlation coefficients, assessing the relationships between various socio-demographic factors and noise sensitivity among inhabitants of Rajshahi metropolitan city. The table includes age, gender, marital status, education level, occupation, income, socioeconomic status, living duration in the city, type of residence, sleep duration, and long-term disease.

A negative correlation was found between age and noise sensitivity ( $\rho = -0.09$ ,  $p < .01$ ), indicating that younger individuals reported higher noise sensitivity compared to older individuals. No significant correlation was observed between gender and noise sensitivity ( $\rho =$

0.02,  $p > .05$ ), suggesting that noise sensitivity does not differ significantly between males and females. No significant relationship was found between marital status and noise sensitivity ( $\rho = -0.07$ ,  $p > .05$ ). A significant positive correlation was found between education level and noise sensitivity ( $\rho = 0.10$ ,  $p < .01$ ), indicating that individuals with higher education reported greater noise sensitivity. The occupation was negatively correlated with noise sensitivity ( $\rho = -0.07$ ,  $p < .05$ ), meaning that individuals in certain jobs (e.g., laborers, drivers) had lower noise sensitivity than professionals or students. Socio-economic status was not significantly correlated with noise sensitivity ( $\rho = 0.06$ ,  $p > .05$ ), indicating that economic background did not strongly influence noise sensitivity in this sample. No significant correlation was found between living duration in the city and noise sensitivity ( $\rho = -0.07$ ,  $p > .05$ ). A positive correlation was found between type of residence and noise sensitivity ( $\rho = 0.07$ ,  $p < .05$ ), indicating that individuals living in shared housing (e.g., hostels, mess) reported higher noise sensitivity. No significant correlation was found between sleep duration and noise sensitivity ( $\rho = -0.01$ ,  $p > .05$ ). No significant correlation was found between long-term disease and noise sensitivity ( $\rho = -0.03$ ,  $p > .05$ ). A strong positive correlation was found between noise annoyance and noise sensitivity ( $\rho = 0.28$ ,  $p < .01$ ), meaning that individuals with higher noise sensitivity also experienced greater noise annoyance. This suggests that noise sensitivity significantly influences how individuals perceive and react to environmental noise.

**Table 2**

*Nonparametric Correlation (Spearman's Rho) Between The Related Factors And Noise Sensitivity Among The Inhabitants Of Rajshahi Metropolitan City (N = 817)*

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Age category	1												
2. Gender	-.19**	1											
3. Marital Status	.67**	.03	1										
4. Education level	-.07*	.02	-.15**	1									
5. Occupation	-.13**	.27**	-.01	-.32**	1								
6. Income category	.30**	-.38**	.20**	.12**	-.66**	1							
7. SES	-.10**	.23**	-.01	.18**	-.11**	.01	1						
8. Living duration	.55**	-.07	.45**	-.05	-.10**	.18**	-.02	1					
9. Type of Residence	-.49**	-.01	-.52**	.13**	.04	-.15**	.00	-.41**	1				
10. Duration of Sleep	-.11**	-.04	-.04	-.01	.03	.02	-.01	-.08*	.04	1			
11. Long term disease	.20**	.01	.16**	-.09**	.08*	-.01	.01	.19**	-.10**	-.13**	1		
12. NAS category	-.09**	.05	-.06	.08*	-.10**	.01	-.01	-.00	.08*	-.04	.04	1	
13. NSS category	-.09**	.02	-.07	.10**	-.07*	-.03	.06	-.07	.07*	-.01	-.03	.28**	1

*Note.*: SES = Socio-economic status

\*\* Correlation is significant at the 0.01 level (2-tailed).

\* Correlation is significant at the 0.05 level (2-tailed).

### **Key Findings:**

- Age, marital status, occupation, socioeconomic status, sleep duration, noise annoyance, and long-term disease were significantly associated with noise sensitivity.
- No significant associations were observed for gender, educational qualification, income level, living duration in the city, or residence type.
- Higher noise annoyance was strongly associated with greater noise sensitivity.
- Younger individuals, unmarried participants, students, and middle-class individuals exhibited higher noise sensitivity.

### **Discussion**

The present study examined the relationship between socio-demographic characteristics and noise sensitivity among city dwellers in Rajshahi, Bangladesh, using chi-square tests and Spearman's Rho correlation analysis. The findings indicate that age, marital status, occupation, socioeconomic status, sleep duration, long-term disease, type of residence, and noise annoyance were significantly associated with noise sensitivity, while gender, education level, income, living duration in the city, and residence type showed no significant relationships.

Both chi-square tests ( $p = .003$ ) and correlation analysis ( $\rho = -0.09$ ,  $p < .01$ ) revealed that younger individuals exhibited greater noise sensitivity than older individuals. This aligns with prior research indicating that younger individuals are more affected by noise due to cognitive demands, academic stress, and occupational pressure (Shepherd et al., 2010; Basner and McGuire, 2018; Thompson et al., 2022). However, some studies have reported higher noise sensitivity among older adults due to increased stress vulnerability and auditory changes (Janssen

et al., 2011). The differences may be due to cultural and environmental factors, as young people in Rajshahi may be more exposed to urban noise pollution.

No significant relationship was found between gender and noise sensitivity in either chi-square ( $p = .45$ ) or correlation analysis ( $\rho = 0.02$ ,  $p > .05$ ). This supports studies suggesting that gender differences in noise sensitivity are minimal and are influenced more by personality traits than biological factors (Guski et al., 2017). However, some studies indicate higher noise sensitivity among females, possibly due to greater physiological arousal and stress responses (Fyhri & Klæboe, 2018).

The chi-square test showed a significant association between marital status and noise sensitivity ( $p = .04$ ), with unmarried individuals exhibiting higher sensitivity than married individuals. This finding supports prior studies indicating that married individuals develop better-coping strategies and social support systems (Beutel et al., 2016). Correlation analysis did not find a significant relationship ( $\rho = -0.07$ ,  $p > .05$ ), suggesting that marital status may indirectly influence noise sensitivity through lifestyle factors such as housing conditions and noise exposure.

A positive correlation was found between education level and noise sensitivity ( $\rho = 0.10$ ,  $p < .01$ ), suggesting that higher education is associated with greater noise sensitivity. This is consistent with findings indicating that highly educated individuals have a higher awareness of noise pollution and a lower tolerance for noise disturbances. However, chi-square analysis found no significant relationship ( $p = .09$ ), suggesting that education alone may not be a strong predictor of noise sensitivity.

Both chi-square ( $p = .005$ ) and correlation analysis ( $\rho = -0.07$ ,  $p < .05$ ) found that students exhibited the highest noise sensitivity, whereas manual labourers (e.g., rickshaw pullers, drivers) had the lowest. This supports research indicating that occupational habituation reduces noise sensitivity, as those regularly exposed to noise develop adaptive coping mechanisms (Basner & McGuire, 2018; Munzel et al., 2018). In contrast, students and professionals require quiet environments for cognitive tasks, making them more susceptible to noise disturbances.

Chi-square analysis found a significant relationship between socioeconomic status and noise sensitivity ( $p = .03$ ), with middle-class individuals reporting higher noise sensitivity than

lower or upper-class individuals. This aligns with studies suggesting that middle-class individuals have higher expectations for quiet environments and lower noise tolerance (Öhrström et al., 2006). However, correlation analysis found no significant relationship ( $\rho = 0.06$ ,  $p > .05$ ), suggesting that socioeconomic status alone does not determine noise sensitivity but interacts with lifestyle and environmental factors.

The correlation analysis found a significant positive relationship between type of residence and noise sensitivity ( $\rho = 0.07$ ,  $p < .05$ ), indicating that individuals living in shared housing (e.g., hostels, mess) exhibited higher noise sensitivity than those living in private homes. This finding is in line with studies suggesting that residing in crowded environments increases exposure to external noise sources, leading to greater annoyance and sensitivity. However, the chi-square test did not show a significant association ( $p = .12$ ), suggesting that other factors, such as personal noise tolerance and coping strategies, may moderate this relationship.

Chi-square analysis found a significant relationship between sleep duration and noise sensitivity ( $p = .029$ ), with individuals who slept 4 to 5 hours reporting the highest noise sensitivity. This is consistent with research indicating that sleep deprivation exacerbates noise sensitivity and stress responses (Basner & McGuire, 2018). However, correlation analysis did not find a significant relationship ( $\rho = -0.01$ ,  $p > .05$ ), possibly due to individual variations in noise adaptation and resilience (Park et al., 2017, Münzel et al., 2021; Riedy et al., 2021).

A significant relationship was found between long-term disease status and noise sensitivity ( $p = .001$ ), suggesting that individuals with chronic illnesses experience greater noise sensitivity. This finding supports research showing that individuals with cardiovascular disease, anxiety disorders, and other chronic conditions are more vulnerable to environmental stressors, including noise (Beutel et al., 2016). However, correlation analysis did not find a significant association ( $\rho = -0.03$ ,  $p > .05$ ), indicating that self-reported disease status alone may not predict noise sensitivity, and other factors such as medication use and coping mechanisms may play a role.

Both chi-square ( $p < .001$ ) and correlation analysis ( $\rho = 0.28$ ,  $p < .01$ ) found a strong positive association between noise annoyance and noise sensitivity, suggesting that individuals who perceive noise as highly annoying are also more sensitive to noise. This aligns with previous

research indicating that noise annoyance is one of the strongest predictors of noise sensitivity (Guski et al., 2017; WHO, 2018, Sarker et al., 2024). These findings highlight the importance of subjective noise perception and coping strategies in determining noise sensitivity levels.

The combined chi-square and correlation analysis findings suggest that younger individuals, students, middle-class residents, and those experiencing high noise annoyance are the most noise-sensitive groups. Noise sensitivity was significantly associated with age, occupation, socio-economic status, type of residence, sleep duration, and long-term disease status. However, gender, income, education, and duration of city residence were not significant predictors. These results emphasize the complex interplay between socio-demographic factors, noise exposure, and psychological noise perception in an urban setting. Future studies should use longitudinal designs and objective noise measurements to further clarify these relationships and inform noise management policies.

### **Limitations and Future Directions**

Despite its contributions, this study has several limitations. First, the cross-sectional design prevents causal interpretations of the relationships between noise sensitivity and socio-demographic factors. Second, the use of self-reported measures may introduce response bias, as individuals may perceive and report noise sensitivity differently. Third, the convenience sampling technique limits the generalizability of the findings to the entire population of Rajshahi or other urban areas in Bangladesh. Lastly, the study did not measure actual noise levels, making it difficult to assess the direct impact of environmental noise exposure on reported sensitivity and annoyance.

Future research should consider longitudinal studies to establish causal relationships between noise exposure, sensitivity, and psychological outcomes. Additionally, using objective noise measurement tools (e.g., sound level meters) alongside self-reported surveys could provide a more comprehensive understanding of noise-related health effects. Expanding the study to multiple cities in Bangladesh could enhance the generalizability of findings. Furthermore, investigating psychological coping mechanisms and intervention strategies to mitigate noise-related stress could inform urban planning and public health policies.

## Conclusion

The present study examined the relationship between socio-demographic factors, noise sensitivity, and noise annoyance among city dwellers in Rajshahi. Findings revealed that age group, marital status, occupation, socioeconomic status, sleep duration, noise annoyance, and long-term disease were significantly associated with noise sensitivity, whereas gender, educational qualification, income level, residence type, and duration of city living did not show significant relationships. Students, younger individuals, and those experiencing high noise annoyance exhibited the highest levels of noise sensitivity. These findings are consistent with previous research but also highlight unique socio-cultural factors influencing noise perception in Bangladesh.

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