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RESEARCH ARTICLE

Noise sensitivity and its associated factors among the students of Rajshahi City in Bangladesh: A cross-sectional study

Pramath Chandra Sarker[1] | Md. Nayamat Ullah[2] | Fahim Morshed[3] | Sabina Sultana[4] | Md. Nur-E-Alam Siddique[4]

[1] Department of Psychology, Rajshahi Goverment College, Rajshahi, Bangladesh
[2]Department of Development Studies, Islamic University, Kushtia, Bangladesh
[3]Department of Public Administration, Islamic University, Kushtia, Bangladesh
[4]Department of Psychology, University of Rajshahi, Rajshahi, Bangladesh

ABSTRACT

Background: Noise pollution is an important environmental problem with far-reaching and unavoidable consequences. The present study aimed to identify noise sensitivity and its associated factors among students of Rajshahi City.

Methods: A total of 473 respondents were selected conveniently from five educational institutions in Rajshahi City. Among them, 273 were women, and 200 were men aged 18 to 28 (mean, 22.9). The Bangla version of the Noise Sensitivity Scale was administered to measure the participants' noise sensitivity level.

Results: Noise sensitivity varied significantly with sleep duration, anger toward noise polluters, level of noise annoyance, and the avoidance of noise-polluted roads (using alternative roads) among the respondents. There was no significant effect of sex or residence in a noise-polluted area on noise sensitivity. The results also indicate that anger at polluters and noise annoyance strongly influence noise sensitivity.

Conclusion: Noise sensitivity affects many aspects of human life. These findings will assist policymakers, and urban planners mitigate the harmful effects of noise sensitivity on human health.

Keywords: *noise sensitivity, noise sensitivity scale, factors associated with noise sensitivity*

INTRODUCTION

The pervasive presence of sounds in our environments is an undeniable part of our daily lives. While sound facilitates communication, entertainment, and environmental awareness,[1] excessive or unwanted sounds, commonly called noise,[2] can harm our well-being.[3]

Noise pollution, a growing concern in Rajshahi City,[4] is a significant environmental stressor that can lead to various health issues. It is especially problematic in densely populated areas, where transportation, construction, and industrial activities contribute to elevated noise levels.[5] This issue is particularly prominent in Bangladesh, which has emerged as a global public health concern.

The effects of noise pollution on human health are well-documented and diverse. Exposure to excessive noises can lead to auditory problems like hearing damage, tinnitus, and various non-auditory effects. These include cardiovascular issues,[6] sleep disturbances,[7] cognitive impairment, psychological disorders like annoyance, stress, and anxiety,[7, 8] and also various social problems like isolation.[9] Additionally, noise pollution impacts the health-related quality of life[10] and decreases sleep quality.[11, 12]

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HIGHLIGHTS

1. One in five students in Rajshahi city has high noise sensitivity.
2. Those with shorter sleep durations have higher noise sensitivity than those with normal sleep durations.
3. People who are more annoyed with noise pollution have higher noise sensitivity.

Furthermore, noise sensitivity can negatively impact academic performance and productivity among students. It can also cause physiological arousal, increase stress levels, impair cognitive functions, decrease concentration, and decrease academic achievement.[7, 8]

While the effects of noise pollution are well-known, the aversion and reaction to noise and a noisy environment is called noise sensitivity.[13] It is a psychological trait that determines an individual's subjective noise perceptions and responses,[14] including both the degree of annoyance and physiological arousal.[13]

Many studies have focused on noise pollution in Bangladesh from engineering and geographical perspectives. However, psychological-based research is limited. Therefore, this study aimed to investigate the noise sensitivity levels and associated factors among students in Rajshahi City, Bangladesh.

METHODS

Sample

This cross-sectional study was conducted from January to February 2024 among conveniently selected university-level students. The sample size was determined using the formula $Z^2 * p * (1-p)/d^2$, where the expected proportion was unknown (p= 0.5) and the desired precision d was 0.05. Although the minimum sample size, using the formula above was 384, we recruited 473 participants.

Data collection

Data were collected in classroom settings using a self-administered questionnaire with due informed consent. Participants were first given instructions on completing the questionnaire. During this process, participants were informed about the study's purpose and assured that their participation was anonymous, confidential, and voluntary. After obtaining consent, students completed the questionnaires, which took 15-20 minutes.

The adapted Weinstein Noise Sensitivity Scale-Short Form (WNSS-SF-Bangla Version) (unpublished) consists of 5 items, deriving from the long-form scale, originally coded as items (Item 7: I get annoyed when my neighbours are noisy. Item 8: I get used to most noise without much difficulty. Item 18: I find it hard to relax in a place that's noisy. Item 19: I get mad at people who make noise that keeps me from falling asleep or getting work done. Item 21: I am sensitive to noise). It had 6-point Likert-type scale responses ranging from strongly disagree (coded as 1) to strongly agree (coded as 6). After reversing the number 8 (recode item), the total noise sensitivity score is obtained by summing the five items. Scores on this scale ranged from 6 (lower noise sensitivity) to 30 (higher noise sensitivity). In this study, the unpublished NSS-SF-BV tool was used, which was adapted by the authors and derived from Benfield *et al.*[14]

Statistical analysis

Descriptive analyses were conducted to ascertain the frequencies and percentages of participants' socio-demographic and noise-related characteristics. Multiple linear regression was done to predict the relationship between noise sensitivity and the associated variables. In the regression analysis, sex, sleep duration, noise-polluted residence, anger at polluters, noise pollution awareness, loud speaking/television volume, and alternative route usage were entered as independent variables in the model, with the noise sensitivity total score as the dependent variable. Statistical significance was determined with an alpha threshold of 0.05. Data analysis was performed using the SPSS version 26.

RESULTS

The study sample included 473 participants, 57.7% women and 76.1% holding bachelor-level qualifications. About 41% resided in rented group accommodations **(TABLE 1)**. We found no statistically significant differences between sexes in terms of noise-sensitive scores. However, participants with lower sleep duration (4-5 hours) had significantly higher noise sensitivity

TABLE 1 Socio-demographic characteristics of participants (n = 473)

Socio-demographic characteristics	Frequency	%
Sex		
Male	200	42.3
Female	273	57.7
Present educational qualification		
Higher Secondary	23	4.9
Graduate	360	76.1
Masters	90	19.0
Present residence		
Home	178	37.6
Hall	88	18.6
Mess	207	43.8

scores compared to those with normal sleep duration (P = 0.04). Those who experienced anger towards polluters also had significantly higher scores (P = 0.002). Additionally, individuals who always used alternative routes to avoid noise-polluted roads reported higher noise sensitivity (P = 0.02), and those with much annoyance due to noise had significantly higher scores (P < 0.001) **(TABLE 2)**.

TABLE 2 Noise sensitivity score in terms of various variables (n=473)

Variables	N	Mean (SD)	*P*
Sex			
Male	200	24.2 (2.7)	0.86
Female	273	24.2 (2.8)	
Sleep duration			
4 & 5 hours (low)	65	24.7 (2.9)	0.04
6 & 7 hours (normal)	296	23.9 (2.7)	
Stay in a noise-polluted area			
Never	171	24.1 (2.8)	0.90
4/5 days in week	32	24.2 (2.6)	
Anger on polluter			
Yes	400	24.4 (2.6)	0.002
No	73	23.2 (3.0)	
Noise pollution awareness			
Yes	458	24.2 (2.7)	0.20
No	15	25.1 (2.6)	
Loud speaking/TV volume			
Yes	73	24.3 (3.1)	0.68
No	400	24.2 (2.7)	
Alternative route usage (avoiding noise-polluted roads)			
All times	229	24.5 (2.7)	0.02
Some times	190	23.8 (2.7)	
Noise annoyance			
Much annoyance	179	25.0 (2.5)	<0.001
Little bit annoyance	274	23.7 (2.7)	

The regression analysis results indicated that anger at polluters (β = -0.11, P = 0.02) and noise annoyance (β = -0.20, P < 0.001) were significantly associated with noise sensitivity **(TABLE 3)**. Among these, noise annoyance emerged as the strongest predictor in the model. These findings highlight that individual perceptions of noise sensitivity are influenced by multiple factors, underscoring the importance of considering various demographic and behavioural elements in understanding these perceptions **(TABLE 3)**.

TABLE 3 Linear regression of noise sensitivity on related factors (n=473)

Variables	Beta coefficient	Standard error of beta	*P*
Sex	-0.02	0.25	0.73
Sleep duration	0.00	0.11	0.93
Noise-polluted residence	0.00	0.14	0.99
Anger on polluter	-0.11	0.35	0.02
Noise pollution awareness	0.05	0.71	0.30
Loud speaking/television volume	-0.03	0.34	0.48
Alternative route usage (avoiding noise-polluted roads)	-0.04	0.18	0.33
Noise annoyance	-0.20	0.26	<.001

DISCUSSION

Noise sensitivity is a personality trait that may predict discomfort and health-related consequences from noise exposure.[15, 16] While noise sensitivity significantly impacts students' sleep duration, annoyance levels, overall well-being, and academic performance,[3] remains an understudied area in research in Bangladesh, especially in urban settings. This study found that individuals with low sleep duration are more associated with noise sensitivity than those with normal sleep duration, suggesting a relationship between sleep quality and noise sensitivity. Consistent with this finding, a study with Chinese people indicated that noise sensitivity increased with nonrestorative sleep. This study demonstrates that noise sensitivity reduces adult sleep duration.[15]

Another finding from the study revealed that anger towards polluters was strongly correlated with increased perceptions of noise sensitivity. A recent study in India also stated that anger at noise polluters and attitudes toward noise pollution are linked.[17] Similarly, an Ecuadorian study found that noise pollution perceptions affected health, happiness, and life satisfaction.[18] The results of these studies align with the present study's findings.

The present study also shows that perceptions vary depending on the level of annoyance with noise. Those who experienced extreme annoyance reported higher sensitivity than those who experienced only lower annoyance. This suggests that individual annoyance levels impact the perceived effects of noise pollution. Studies have demonstrated that an individual's annoyance levels can substantially influence how they perceive the consequences of noise pollution.[13] Yu *et al.*[19] found that physiological and psychological factors can influence tolerance levels. The results indicate that an individual's tolerance levels significantly impact how they perceive noise pollution.

Conclusion

Although our study has the limitations of having done in purposively recruited subjects and lacks national representation, it provides an important basis for large-scale studies. Various factors, such as sleep duration, anger towards noise polluters, and overall irritation from noise, influence students' noise sensitivity. The findings indicate that students who sleep less and experience higher levels of annoyance due to noise exhibit greater noise sensitivity. This highlights the importance of addressing noise sensitivity issues among students.

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Author contributions

Conception and design: PCS, SS, MNAS. *Acquisition, analysis, and interpretation of data:* PCS. *Original manuscript drafting:* PCS, MNU, FM. *Review and editing:* PCS, SS, MNAS, MNU, FM. *Approval of the final version of the manuscript:* PCS, SS, MNAS, MNU, FM. *Guarantor of accuracy and integrity of the work:* PCS, MNU, FM.

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Conflict of interest

We do not have any conflict of interest.

Ethical approval

Ethical clearance has been obtained from the Institutional Animal, Medical Ethics, Biosafety, and Biosecurity Committee (IAMEBBC) at the Institute of Biological Sciences (IBSc), University of Rajshahi Research Ethics Committee (Reference No.: 455(12)/320/ IAMEBBC/ IBSc; Date: 14/09/2023).

Data availability statement

The authors confirm that the data supporting the findings of this study are shared upon request of the corresponding author.

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