Adolescent Students' Distress and Noise Exposure in Classrooms near an Industrial Area

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Abstract

Background: Classroom noise has been found to have a wide range of detrimental consequences on children's academic performance, including difficulty with concentration and memory. There has been little research on noise annoyance in children, compared to adult noise annoyance. Noise is a public health issue that causes annoyance and has an impact on children's health. Children are more prone to exposure to noise.

Objective: To assess the relationship between classroom noise exposure and the annoyance of secondary school students.

Methods: This was a cross-sectional study involving both male and female secondary school students from classes VIII through X. Respondents were selected by convenience sampling technique from Mawna Multilateral High School, Gazipur. To collect data from respondents, used a semi-structured questionnaire and a face-to-face interview and study tools include a calibrated smart phone (Android) app and a checklist.

Results: The mean age of 422 respondents was 14.76 (±1.007) years. The ages of the respondents were between 13 to 16 years. Most (30.6%) were 14 years of age, (29.9%) were 16 years of age, (28.0%) were 15 years of age and the rest of them (11.6%) were 13 years of age. Among the respondents, 35.3 % were taken from class VIII, 41.5% from class IX and 23.2% from class X. Among them, 50.95% were male and the rest 49.05% were female. Most of them 93.36% were Muslims and 6.64% were Hindus. The family income of the respondents ranged from 5000 Taka to 105000 Taka and their mean income was 30318.72(± 20732.225) Taka. The Bangladesh Noise Pollution (Control) Rules 2006 state that the standard level of noise in mixed areas is between 50 and 60 dB. Based on the mean of these weekly average noise levels, which was 87.6 dB, it may be concluded that the selected school's classroom was noisy.

Conclusion: This research may help to improve secondary school students' academic performance and establish a happy learning environment. Benefits include providing parents and school administrators with relevant information about how classroom noise affects student health and academic performance, as well as how it annoys secondary school students.

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Introduction

Noise is recognized as a major environmental issue, particularly in urban areas, affecting quality of life and well-being.[1] According to the World Health Organization, noise ranks second among the environmental risk factors to public health.[1]

Environmental hazards like noise can cause nausea and unpleasant stimuli which can lead to negative emotional reactions like dislike, anger, or disgust. Noise pollution is a sort of air pollution defined as an audible, unwanted sound that is hazardous to one's health and well-being.[2] Noise is any unwanted sound that either directly or indirectly endangers the lives of humans or animals. It means the sound is in the wrong place at the wrong time which causes feelings of annoyance and irritation, fatigue and damage to the auditory system.[2]

A logarithmic decibel (dB) scale is used to assess noise exposure and to describe noise in terms of loudness and pitch. A person's ability to tolerate noise is influenced by a variety of personal characteristics, including age, gender, and temperament. Environmental noise is any undesired sound caused by human activity that is bad for people's health or quality of life.[3] Globally, noise pollution is a serious issue with numerous negative health effects. Over the past ten years, urbanization, industrialization, road system expansion, and an increase in the number of motor vehicles in both the public and private sectors have all contributed to major changes in Bangladesh's urban environment, a growing nation. Urban environments have become home to noise pollution, which has grown to be an obtrusive problem that society finds unacceptable.

Any factor or state that makes someone or a group of people angry or displeased is referred to as annoyance. Twenty million people in Europe have noise-related stress, and eight million experience sleep difficulties as a result of noise pollution.[4] Any noise that disrupts communication, phone conversations, radio or TV listening, or children's learning in any setting individually or in a group, together or apart is considered annoying. Noise can also affect children's ability to perform various tasks. For example, children are more likely to give up on solving difficult puzzles in noisier situations. Even when a child is no longer educated in a noisier environment, the tendency to more easily give up persists.

The distraction of interfering noise can be greater for younger children and speech sounds can be a more disturbing type of noise than more neutral ventilation-type noises.[5] Even noise can increase the level of stress hormones that can have negative effects on students' motivational drive towards learning. Moreover, continuous noise exposure produces deficits in task performance which is linked to learned helplessness. Both acute and chronic exposure to noise, crowding, traffic congestion, and pollution are responsible for causing learned helplessness among children.

Noise irritation is defined as "a person's negative response to noise". Social and psychological factors that are aggravated by weaker family members, child development, and disability include views toward the aggressor, the person causing the problem, and the appropriate authorities. Their performance and learning are disrupted by their health and quality of life. Factors such as age, gender, socioeconomic status, and noise phobia are significant. To calculate each person's noise threshold for irritation.[6]

Environmental noise sources and concerns about their impact on noise sensitivity aggravate annoyance. Acoustic characteristics are used to estimate 33% of

each person's noise discomfort.[7] Road traffic is expected to be the main external noise source, although aircraft noise may also have an impact on many schools. Railway noise is likely to be heard in fewer schools.[8] The most common sources of noise outside London schools were automobiles (86%), airplanes (54%), lorries (35%), and buses (24%), with railway noise being a source outside 11% of schools.[8] Children in secondary school require a serene and comfortable work atmosphere, such as a school. Policymakers are concerned with safeguarding these age groups from potentially detrimental situations, such as noise pollution.

Objective

To assess the relationship between classroom noise exposure and the annoyance of secondary school students.

Methods

Study design and settings: This was a cross-sectional study done on a selected school students. The study was conducted for a period of one year from 1st January 2023 to 31st December 2023. The school's name was Mawna Multilateral High School, Gazipur, Bangladesh. Noise measurement was conducted in classrooms. The sound level was measured for 1 hour by the noise capture app and saved.

Sample selection: Secondary school children from class VIII to X were taken as the study population for conducting the study. The children were taken from three types of classes by convenience sampling according to their accessibility and availability. Written assent was obtained from all individuals before they participated in this study.

Data Collection: Although the school maintains a busy schedule and academic curriculum, enough time was provided for talking with the respondents to build a bridge of communication. After an explanation of the purpose of the study to the participants, a brief instruction to the respondents was given. Then the data was collected by face-to-face interview with a set of semi-structured questionnaires maintaining confidentiality.

Noise exposure assessment: Noise exposure was assessed by measuring the equivalent noise level of that school's classrooms by the following formula:

For each hour continuous Noise Level (Leq) was measured by following procedure:[9]

NC=L10-L90

NC: Noise Climate

Equivalent noise level for 1 Leq= L50+ $[(NC)^2/60]$

Leq (equivalent sound level): A widely used noise parameter describing a sound level with the same energy content as the varying acoustic signal measured.

L10: the noise level just exceeded 10% of the measurement period.

L90: the noise level exceeded for 90% of the measurement period.

L50: the noise level exceeded for 50% of the measurement period

These parameters were used for the evaluation of Noise Climate (NC), Equivalent Continuous Noise Level (Leq).

NC: Noise Climate

After measuring the equivalent noise level for 1 hour, the equivalent noise level for that day (3 hours of that day) was measured by following formula[10]

Leq= 10 log10 [$t_1 10^{L1/10} + t_2 10^{L2/10} + t_3 10^{L3/10}$]

t1= fraction of time representing the hours 9:00 a.m. to 10:00 a.m. (that was = 1/3)

t2 = fraction of time representing the hours 11:00 a.m. to 12:00 p.m. (that was = 1/3)

t3 = fraction of time representing the hours 1:00 p.m. to 2:00 p.m. (that was = 1/3)

L1 = Leq from 9 a.m to 10 a.m

L2 = Leq from 11 a.m to 12 p.m

L3 = Leq from 1 p.m to 2 p.m

Statistical Analysis: The data were analyzed in IBM SPSS version 27.

Descriptive statistics such as mean, standard deviation and percent were computed for continuous variables of the participants. Socio-demographic and level of annoyance from the questionnaire were analyzed by descriptive statistics. Chi-square was used to assess the significance association between two variables and a p-value of <0.05 at a 95% confidence interval was taken as significance. The results were presented in tables.

Ethical approval: Informed written consent was obtained from each participant. Ethical approval was obtained from the Institutional Review Board (IRB) of the National Institute of Preventive and Social Medicine (NIPSOM), Dhaka 1212, Bangladesh (NIPSOM/IRB/2023/03).

Results

Table I depicts the Particulars of the respondents. The mean age of 422 respondents were 14.76 (±1.007) years. The age of the respondents were between 13 to 16 years. Among the respondents, 35.3 % were taken from class VIII, 41.5% from class IX and 23.2% from class X. The family income of the respondents ranged from 5000 Taka to 105000 Taka and their mean income was 30318.72 (± 20732.225) Taka. About three-fourth percent (74.9) % had a personal study room and only 25.1 % of respondents had no personal study room.

Table I: Particulars of the respondents (n=422)

Particulars		Frequency	Percentage (%)
Age group (Years)	13	49	11.6
	14	129	30.6
	15	118	28.0
	16	126	29.9
	Mean±SD		14.76 (±1.007)
Gender	Male	215	50.9
	Female	207	49.1
Religion	Islam	394	93.4
	Hindu	28	6.6
Class	Class VIII	149	35.3
	Class IX	175	41.5
	Class X	98	23.2
Income	5000-30000	297	70.4
	30001-55000	85	20.1
	55001-80000	24	5.7
	≥80001	16	3.8
	Mean±SD		30318.72(±20732.225)
Father's educational level	Never attended school	43	10.2
	Primary level	77	18.2
	Secondary level	149	35.3
	Higher Secondary and above	153	36.2
Mother's educational level	Never attended school	25	5.9
	Primary level	90	21.3
	Secondary level	188	44.5
	Higher Secondary and above	119	28.2
Personal study room	No	106	25.1
	Yes	316	74.9
Study period (Years)	1	95	22.5
	2	74	17.5
	3	116	27.5
	4	92	21.8
	5	45	10.7

Table II: Distribution of study participants by levels of annoyance

Levels of annoyance	Frequency	%
Not at all annoyed	15	3.6
Slightly annoyed	89	21.1
Moderately annoyed	220	52.1
Very annoyed	98	23.2
Total	422	100.0

Table II shows the levels of annoyance among the participants of secondary school students. Most of the participants in the study about 220 (52.1%) were moderately annoyed, 98 (23.2%) were very annoyed, 89 (21.1 %) were slightly annoyed and only 15 (3.6%) were not at all annoyed due to exposure of classroom noise in the school environment.

Table III: Daily & weekly noise level

Week	Day	Daily noise level (dB)	Weekly noise level (dB)	Measured noise level (dB)
1	1	84.73	85.8	87.6
	2	84.59		
	3	88.01		
2	4	89.05	89.3	
	5	96.45		
	6	82.36		
3	7	89.05	89.4	
	8	92.01		
	9	87.12		
4	10	86.47	85.8	
	11	85.74		
	12	85.25		

Table III shows the distribution of noise levels 3 days a week with the lowest weekly value of 85.8 dB to the highest 89.4 dB. The average measured noise level of that school classroom was 87.6 dB.

Table IV: Noise exposure level

Weekly average noise levels (dB)	Measured noise level (dB)	Standard noise level (dB)
85.8	87.6	50-60
89.3		
89.4		
85.8		

*Bangladesh Noise Pollution (Control) Rules 2006

Table IV shows the distribution of weekly average equivalent noise levels with measured and standard noise levels for mixed areas illustrating that the measured level is higher than the standard level.

Table V: Distribution of participants by study room and monthly family income

	Income of respondent's family				
Study room	5001-30000	30001-55000	55001-80000	≥80001	Total
No	95(89.6%)	9(8.5%)	0 (0.0%)	2 (1.9%)	106(100%)
Yes	202(63.9%)	76 (24.1%)	24(7.6%)	14 (4.4%)	316(100%)
Total	297 (70.4%)	85(20.1%)	24 (5.7%)	16 (3.8%)	422(100%)

(X^2 = 26.394, df = 3, p ≤0.001)

Table V shows the relation between own study room of the participant with the income of participant's family. Statistically significant relationship was found, so association might be present between own study room of the participant with income of participant's family.

Table VI: Distribution of participants by levels of annoyance and gender

	Levels of annoyance				
Gender	Not at all annoyed	Slightly annoyed	Moderately annoyed	Very annoyed	Total
Male	11 (5.1%)	48(23.3%)	98(45.6%)	58(27.0%)	215(100%)
Female	4(1.9%)	41(19.8%)	122(58.9%)	40(19.3%)	207(100%)
Total	15(3.6%)	89(21.1%)	220(52.1%)	98(23.2%)	422(100%)

(X^2 = 9.593, df = 3, p ≤0.022)

Table VI shows the relationship between levels of annoyance and gender. Among all the respondents most males (45.6%) and females (58.9%) were moderately annoyed, males (27.0%) and females (19.3%) were very annoyed, males (23.3%) and females (19.8%) were slightly annoyed and male (5.1%) and female (1.9%) were not annoyed. A statistically significant relationship was found, so an association may be present between levels of annoyance and gender.

Table VII: Distribution of participants by levels of annoyance and age

	Levels of annoyance				
Age	Not at all annoyed	Slightly annoyed	Moderately annoyed	Very annoyed	Total
13	0 (0.6%)	14(9.6%)	24(55.1%)	11(23.6%)	49(100%)
14	2(1.6%)	33(25.6%)	67(51.9%)	27(20.9%)	129(100%)
15	3(2.5%)	19(16.1%)	60(50.8%)	36(30.5%)	118(100%)
16	10(7.9%)	23(18.3%)	69(54.8%)	24(19.0%)	126(100%)
Total	15(3.6%)	89(21.1%)	220(52.1%)	98(23.2%)	422(100%)

(X^2 = 19.0, df = 9, p ≤0.025)

Table VII shows the relationship between levels of annoyance and the age of the respondents. A statistically significant relationship was found, so an association may be present between levels of annoyance and the age of the respondents.

Discussion

This cross-sectional study was conducted among 422 secondary school Students who were exposed to classroom noise in the selected schools of Gazipur city in Bangladesh. A convenience sampling technique was followed and each sample from every measured noisy classroom in the school. Data were collected by face-to-face interviews of the respondents using a pre-tested semi-structured questionnaire. Distribution of noise levels 3 days a week with the lowest weekly value of 85.8 dB to the highest 89.4 dB. Their average value was chosen as the measured noise level of that school classroom which was 87.6 dB. The noiselevels in the school were so high that could not fulfill the recommended noise level in the school environment. Distribution of weekly average equivalent noise levels with measured and standard noise levels for mixed areas that illustrates that the measured level is higher than the standard level. [Bangladesh Noise pollution (Control) Rules 2006]. According to the Department of Environments (DOE) of Bangladesh and WHO, the noise label in schools during teaching sessions is 45 dB and 35 dB respectively. A similar study was conducted for the assessment of noise levels in selected secondary schools.[11] They got mean noise levels across the schools were between 69.5 dBA and 76.1 dBA inside the classroom. The age of the respondents was between 13 to 16 years and their mean age was Mean 14.76 (±1.007) years. Among 422 respondents, most (30.6%) were 14 years of age, (29.9%) were 16 years of age, (28.0%) were 15 years of age and the rest of them (11.6%) were 13 years of age. A similar study was conducted in Italy including participants having a mean age of 14.1+2.2 years 67% of them were >14+ years and 33% of them were < 14 years.[1]

The majority (50.9%) were male and the rest (49.1%) were female. Among 422 respondents (93.4 %) were Muslims and a few (6.6 %) were Hindu. Distribution of secondary school students by their academic class. They were selected from classes VIII to X. Among 422 respondents 35.3% belong to class VIII, 41.5% belong to class IX and 23.2% belong to class X. The monthly income of the respondent's family ranged from Tk. 5000 to Tk. 105000 and their mean family income was 30318.72 (± 20732.225) Taka. Among 422 respondents, most (70.4%) were between 5000-30000 Taka, 20.1% were between 30001-55000 Taka, 5.7% were between 55001-80000 Taka, some (3.8%) were within ≥80001 Taka. The monthly income of the respondent's family is reflected as a medium economic country of the world. A similar study was conducted in Berlin, Germany 25.4% were of low socio-economic status, 47.5% medium and 28.7% were higher socio-economic class.[12] Among the fathers of 422 respondents 10.2% had never attended school, 18.2% had completed primary level, 35.3% had secondary level qualification, 36.2% had completed higher secondary and above. Among the mothers of 422 respondents, 5.9% had never attended school, 21.3% had completed primary level, the majority 44.5% had the secondary level qualification, and 28.2% had completed higher secondary and above. Most (74.9%) of them hada study room and only 25.1% had no study room. The distribution of secondary school students by duration in school (in a year). Among 422 respondents, 67.5% were between 1-3 years and 32.5% of them were between 4-6 years. The distribution of secondary school students by study period shows among 422 respondents, 27.5% were 3 years of the study period, 22.5% of them were 1 year of the study period, 21.8% of them were 4 years of the study period, 17.5% of them were 2 years of the study period, 10.7% of them were 5 years of the study period.

Anything responsible for the production of sound is incorporated as environmental noise. In this study of selected schools. Among 422 respondents, 49.8% of them sometimes reported noise source as road traffic, 35.3% noticed noise originating from the classroom, 7.6 % respondents answered noise source as voice, 4.3% reported noise source as sound system, 1.7% respondents answered noise source as construction work inside the school and only 1.4% of the respondents informed that noise was coming from school premise. Other sources of noise also play a significant contribution to the production of noise in the school environment. A similar study conducted in France revealed the main source of the noise was road traffic and it was independently associated with annoyance.[13] The annoyance index is the result of average scores of answers to questionnaire items, used to measure both the individual annoyance and the perceived noise exposure. The annoyance index was the indicator of noise exposure. It ranges from 0.0 to 1.0. So value close to zero was less or not annoyed.[1]

The study the level of annoyance among the participants of secondary school students. Most of the participants in the study about 220 (52.1%) were moderately annoyed, 98 (23.2%) were very annoyed, 89 (21.1 %) were slightly annoyed, and only 15 (3.6%) were not at all annoyed due to exposure of classroom noise in the school environment. A similar study was conducted but they did not find any difference between age and level of annoyance due to environmental noise.[14] Annoyance can happen in any member of the family. Some studies revealed that children of low socioeconomic status were more annoyed by road traffic noise during the daytime than children of medium and higher socioeconomic status.[12] In this study statistically significant relationship was found, so an association may be present between own study room of the participant with income of the participant's family, association may be present between levels of annoyance and gender. Also between levels of annoyance and age of the respondents. Statistically, no significant relationship was found, so an association was absent between levels of annoyance and the study period. Also absent between academic classes with their levels of annoyance. A statistically significant relationship was not found between levels of annoyance and monthly family income.

Conclusion

Noise causes environmental problems. Everything around us could be a risk factor for the environment as well as people of all ages and genders. Noise will have an impact on all living things on the planet, not just humans. The prevalence of annoyance in secondary school students was high. Most of the participants in the study were moderately annoyed. Appropriate, effective, coordinated policy formulation and implementation need to be established by government agencies and stakeholders related to educational sectors of all levels.

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