CLASSROOM NOISE EXPOSURE AND ACADEMIC PERFORMANCE OF SECONDARY SCHOOL CHILDREN

1*Dr. Abdullah Al Mamun, 2Dr. Md. Shafiur Rahman, 3Dr. Md. Asif Jamil Pritom, 4Dr. Foyzunnahar Munmun

National Institute of Preventive and Social Medicine (NIPSOM), Mohakhali, Dhaka-1212, Bangladesh.

*Corresponding Author: Dr. Abdullah Al Mamun

National Institute of Preventive and Social Medicine (NIPSOM), Mohakhali, Dhaka-1212, Bangladesh.

ABSTRACT

Noise means the sound in the wrong place in the wrong time that causes feeling of annoyance and irritation, fatigue and damage to the auditory systems. A variety of things, including machinery, vehicles, electrical gadgets, and human activity, can produce noise. In the dynamic realm of education, the interplay between classroom environment and academic achievement has emerged as a focal point of scholarly inquiry, with particular attention given to the impact of classroom noise on the learning outcomes of secondary school children that demands more research in this field. However, research on the relationship between classroom noise exposure and academic performance in secondary school children is limited. This study aimed to assess the relationship between classroom noise exposure and academic performance in secondary school children. It was a cross sectional study conducted from 1 January 2023 to 30 November 2023. Secondary school children of class VIII to class X were included. In this study convenience sampling technique was used. The study was conducted in Mawna ML High School, Gazipur district, using semi-structured questionnaire and data were collected from the respondents by face-to-face interview. A calibrated smart phone app was used to take the noise values in (dB) and put them into checklist for calculation and measuring the noise of classroom. Assent from the participants were obtained, confidentiality of participants' data was ensured. In this research male and female students were almost equal and most of them were Muslims and some were Hindus. Most of them belongs to middle class family and a larger part of study population has no study room. Average weekly equivalent noise was measured in the classroom as 1st week 90.4 dB, 2nd week 90.3 dB, 3rd week 86.8 dB and 4th week 86.8 dB respectively. The mean of these weekly average Leqs was 88.6 dB that was higher than standard level of noise (50-60) dB in mixed areas according to Bangladesh Noise Pollution (Control) Rules 2006 and it concludes that the classroom of the selected school was noisy. Academic performance of the children was measured by score of academic performance scale in which most of the participants belongs to moderate academic performance (70.4%) that illustrates the effect of noise on school children. The benefits of this study might include providing valuable insights into the effects of classroom noise exposure on the academic performance of secondary school children, which could inform school administrators and parents to improve health and academic outcomes for school going children.

KEYWORDS: Classroom Noise Exposure, Academic Performance, School Children.

INTRODUCTION

We live in a noisy world. It is an inevitable aspect of daily life and has significantly decreased people's quality of life. Noise is derived from the Latin word "nausea" which means loud, unpleasant, or unexpected sound. Noise pollution is a type of air pollution that is described as an audible, unwelcome sound that is harmful to someone's health and wellbeing.[1] Noise is divided into two broad categories: environmental and occupational noise. While occupational noise is related to noise-exposed from the working environment, environmental noise is related to noise nuisance and community noise. Despite its detrimental effects on individuals, environmental noise is often ignored since it cannot be seen or tasted.[2] Not only are established nations like the United States and Europe plagued by noise pollution, (Peterson,1983) but also are developing nations like Bangladesh. In Bangladesh, urbanization is rapidly increasing in tandem with population increase. Urban environments have become home to noise pollution, which has grown to be an obtrusive problem that society finds unacceptable. Indeed, noise has been a constant threat since the industrial revolution. There are numerous national and international standards pertaining to classroom acoustics. These mainly take the form of recommended values for reverberation time and

background noise levels in teaching spaces, together with sound insulation regulations for schools. For example, 35 dB LAeq is the recommended background level for schools during teaching sessions, according to the World Health Organization's (WHO) Guidelines for Community Noise. Additionally, an ANSI standard that was just passed in the USA recommends this level. In July 2003, laws pertaining to noise and acoustics in schools were introduced in the United Kingdom. Building Bulletin 93 contains the necessary acoustic regulations. It states that noise from sources such as ventilation plants and invasive external noise in unoccupied teaching rooms must not exceed a maximum ambient level of 35 dB LAeq for 30 minutes.[3] Children in school may be exposed to noise from a wide range of sources. A variety of ambient noises, such as those from industrial processes, plants, vehicles, and individuals outside the school, are likely to constitute external noise. Rain falling on light- colored school roofs is another source of noise that is said to seriously disrupt teaching. 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.[3] According to a Shield and Dockrell survey conducted in 2000, the most common sources of noise outside London schools were automobiles (86%), aeroplanes (54%), lorries (35%), and buses (24%), with railway noise being a source outside 11% of schools. The distribution of sources seen outside of homes in the UK during the 2000–2001 National Noise Incidence Survey (NNIS) is in close agreement with this distribution; for instance, the NNIS reported that 87% of homes were exposed to noise from road traffic and 12% were exposed to noise from railroads. Therefore, it is reasonable to conclude that these numbers represent the usual level of noise exposure in industrial societies' classrooms.[3] It is commonly known that environmental noise from automobiles, trains, airports, and industrial sites negatively impacts people's health and wellness. These effects include heart disease, disturbed sleep, irritation, and cognitive decline. Over the past thirty years, a large number of studies have examined the impact of noise on children's learning and performance in school. A growing amount of empirical evidence indicates that prolonged exposure to high decibel noise is detrimental to cognitive functions such as reading, attention, memory, learning, and problem- solving.[4] The school is a microclimate that is crucial to children's cognitive development and noise is an important part of this microclimate. The most obvious roles of schools are to impart knowledge of curriculum subjects, encourage students' enthusiasm for learning, and assist cognitive development. It's essential to guide children in understanding social values, preparing for adult responsibilities, develop psychologically and ultimately shaping them for future leadership.

MATERIALS AND METHODS

Study design and setting: A cross sectional study was conducted to assess the relationship between classroom noise exposure and academic performance of secondary school students of selected school. The entire process took place in 2023 from January to December. Selected school of Gazipur District, located along the road was the study place. The school name was Mawna ML High School. The school is 66 KM away from Dhaka zero point (according to google map). The school and three classrooms (VIII, IX, X) were chosen by purposive sampling. Noise measurement was conducted in classrooms. Sound level was measured for 1 hour by noise capture app and then saved according.

Participants: Secondary school children from class VIII to X were taken as 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 their participation 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 explanation of the purpose of the study to the participants a brief instruction to the respondents was given. Then the data of socio-demographic characteristics and academic performance was collected by face to face interview with a set of semi-structured questionnaire maintaining confidentiality. Academic performance was measured later by Academic Performance Scale.

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

$$\text{Leq} = 10 \log_{10} [\, t_1 10^{L1/10} + t_2 10^{L2/10} + t_3 10^{L3/10}]$$

t_1= fraction of time representing the hours 9:00 a.m. to 10:00 a.m. (that was = 1/3)

t_2 = fraction of time representing the hours 11:00 a.m. to 12:00 p.m. (that was = 1/3)

t_3 = 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.[5]
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 for 10% of the measurement period/peak sound level
L90: the noise level exceeded for 90% of the measurement period/mean sound level in 1 hour
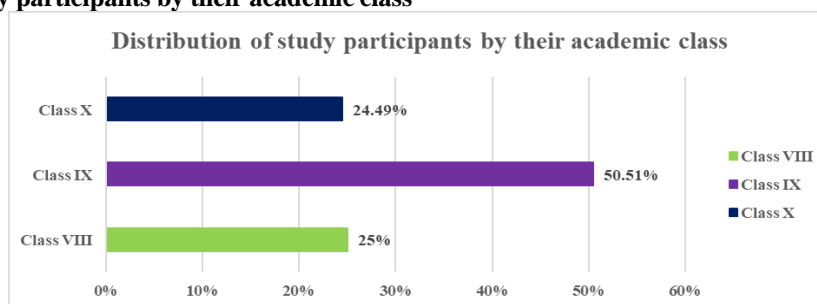L50: the noise level exceeded for 50% of the measurement period/background or residual sound level.

Data Analysis: Data obtained from questionnaire were entered in SPSS software. Socio-demographic and academic performance data from questionnaire were analyzed by descriptive statistics. Chi-square test was done to see the relationships between variables of socio-demographic and academic performance but wasn't applicable for findings of noise measurements due to constant values of noises. Finally, academic performance score was computed and interpretation was done.

Ethical considerations: The research was conducted through data collection using questionnaires and noise measurement by android "Noise Capture" app. No other interventions or invasive procedures were performed. Formal approval for the study was obtained from the NIPSOM Institutional Review Board. Before commencing the study, each participant and his or her parents were informed about the study and assent was obtained. Participation in the study was completely voluntary. They were informed that they had the right to refuse to answer any or all interview questions and that they also had the right to withdraw from the current interview. This study didn't take into account gender sensitivity, ethnic sensitivity, cultural and political sensitivity. Subjects were clearly informed about the nature, purpose and security of data processing.

RESULTS
Children enrolled in a selected roadside school in the Gazipur district participated in this cross-sectional study. A semi-structured pretested questionnaire was used to interview 196 respondents in total.

Figure 1: Distribution of study participants by age.

Among 196 respondents, majority (66.8%) were between 12-14 years of age and the rest of them (33.2%) were between 15-17 years of age.

Table 1: Distribution of study participants by gender.

Gender	Frequency (%)
Male	100 (51.02)
Female	96 (48.98)
Total	196 (100)

The participation of male and female was almost equal. The study gathered 51.02% data from males and 48.98% data from females.

Table 2: Distribution of study participants by religion.

Religion	Frequency (%)
Muslim	181 (92.3)
Hindu	15 (7.7)
Total	196 (100)

Regarding religion, the findings revealed that greater proportion of respondents were Muslim, accounting for 181 out of 196 individuals (92.3%).

On the other hand, individuals believe in Hinduism constituted a slightly smaller group (7.7%) only.

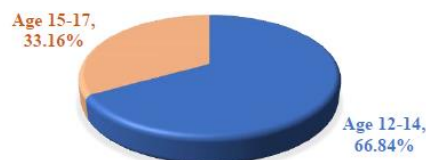**Distribution of study participants by their academic class**

Figure 2: Distribution of study participants by their academic class.

Regarding academic class, the study states that 50.51% of the respondents (99 out of 196) were from Class IX and rest were from Class VIII & X.

Table 3: Distribution of study participants by their family's monthly income.

| Monthly income (BDT)	Frequency (%)
5001-30000	121 (61.7)
3001-55000	48 (24.5)
≥55001	27 (13.8)
Total	196 (100)
Minimum income 8500 Taka	
Maximum income 100000 Taka	

Regarding family's monthly income, the findings revealed that participant's family's monthly income ranges from 8500 taka to 100000 Taka. Greater proportion of respondent's family income was up-to 30000 Taka accounting for 121 out of 196 individuals (61.7%). Rest of the participant's family income were above 30000 Taka to maximum 100000 taka.

Table 4: Noise exposure level.

Weekly average noise levels (dB)	Measured noise level (dB)	Standard noise level (dB)
90.4		
90.3	88.6	50-60
86.8		
86.8		

[Bangladesh Noise pollution (Control) Rules 2006]
Regarding noise exposure level, this study revealed the distribution of weekly average equivalent noise levels in that school's classrooms with measured and standard noise level for mixed areas that illustrates that the measured level is higher than the standard level (50 dB – 60 dB).
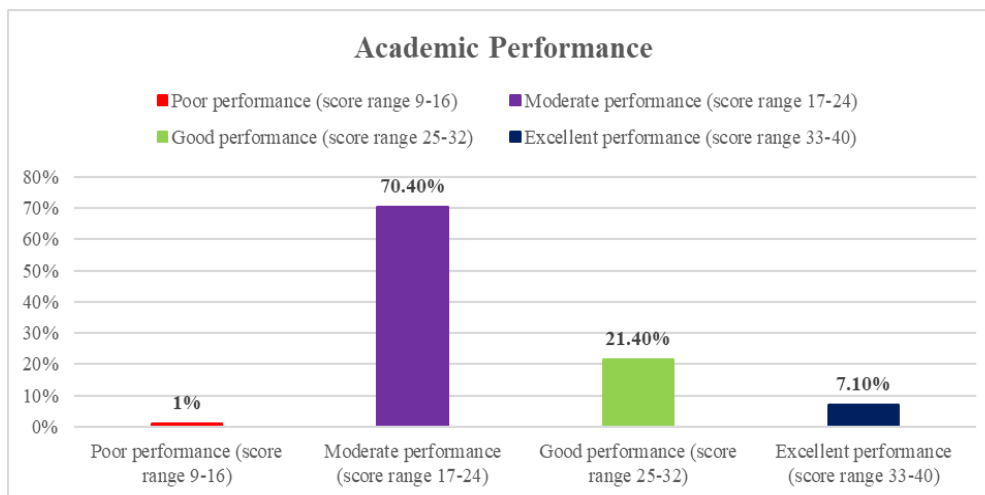
Figure 3: Distribution of academic performance of children under study that were measured by Academic Performance Score.

Regarding academic performance, this study evaluated that academic performance score of the respondents were ranging from 9 to 40 with minimum score 15 to maximum score 40. Among 196 respondents, majority (70.4%) of them achieved score of moderate performance, 21.4% respondents attained score of good performance, 7.1% participants stated that their academic performance were excellent and only 1% respondents were in row of poor performance.

DISCUSSION
The study was conducted among 196 secondary school children of selected school to assess the relationship between classroom noise exposure level and academic performance score. Participants were selected from class eight, nine and ten. Data was collected through face-to-face interviews using a semi-structured questionnaire. The study involved 51.02% males and 48.98% females, with 92.3% Muslim and 7.7% Hindu. Family income ranged from 8500 taka to 100000 taka. Most respondents were from 12-17 years old. After measurement of noise, the average of all equivalent weekly noise was found 88.6 dB that was more than accepted level of sound, whereas according to Bangladesh Noise pollution (Control) Rules 2006 perfect sound condition for mixed areas in Bangladesh is 50-60 dB which denotes that the classroom was noisy. The measurements were taken in classrooms when occupied with students and were busy in normal classroom activities in presence of their class teachers. The study found that noise exposure in school classrooms may negatively impact students' academic performance, with

70.4% achieving moderate performance, and 1% experiencing poor performance, suggesting a potential link between noise exposure and academic decline. Buchari and Matondang's study found that the noise level at Public Primary School of Medan is too high, affecting students' learning and academic performance, with an average of 86.8 dBA, higher than standard noise levels. Xie, Kang, and Tompsett's study found no significant relationship between classroom noise exposure and academic performance in Inner London secondary schools. In this study, no significant relationship was found between classroom noise exposure and academic performance. Sheild and Dockrell's research indicates that noise significantly impacts children's school performance, with older elementary school-age children most affected. In this study, younger children were more affected than older children by noise and noise level was high in classroom. Sheild and Dockrell found that long-term exposure to noise in elementary schools negatively impacts academic performance and achievements. In comparison, this study suggest that the higher noise may have association with academic performance but statistically significant association was not found. This high level of noise can cause harmful effect not only for the children but also for the teachers and other school staffs of the institute.

Therefore, two aspects need to be taken into consideration in order to minimize the influence that noise has on students at school. Schools should be situated and designed internally so that classroom noise levels from outside sources, including traffic, are kept to

a minimum. To guarantee that the best possible circumstances for teaching and learning are met, it is also crucial to reduce background noise levels in the classroom. Further field and experimental researches are needed to determine the extent to which different types of noise affect children's academic performance in different context.

LIMITATIONS
1. Because of busy schedule of school, it was too hard to find student's free time for data collection.
2. As I approached to students of that school, they got new ideas and gathered which impaired the data collection process.
3. The study population was selected from only one school. So, the result of the study may not represent of the exact picture of overall situation.
4. The use of smart phone for measurements of noise levels may be subjected to be different because of instrumental variation.
5. Other factors, such as teacher quality and student motivation, can also affect academic performance but are not actually mentioned in this study.

CONCLUSION
The study explored the link between classroom noise exposure and academic performance in secondary school students. The research shows that classroom noise levels are higher (88.6 dB) than recommended (50-60 dB), particularly in areas without acoustic treatment. Regular exposure to classroom noise leads to moderate academic performance. The study suggests a need for a comprehensive strategy to improve learning experiences and explores specific noise sources for customized solutions.

RECOMMENDATIONS
1. Classroom noise reduction system can be introduced.
2. Promoting noise-cancelling policies outside of school premises can help create a more tranquil environment.
3. Integration of sound masking systems or cutting-edge audio technologies for overall improvement of learning environment in classrooms.
4. Creating training courses for teachers to increase their knowledge of the negative effects of noise on students' academic performance as well as to give them the tools for effective control of classroom noise is necessary.

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