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Quantitative assessment of noise level around the educational institutions in Ranchi, Jharkhand, India

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ABSTRACT

The presented research was carried out to assess the noise level around the four reputed educational institutions of Ranchi. The noise level was measured with the help of Sound Level meter with A - weighted noise level in all the four areas of educational institutions understudied. The measurement was taken from 6.00 AM to 6.PM with 2 hours of time intervals during daytime in seven regular working days and holidays. The result observed was above the limits prescribed by the CPCB ambient limit of noise. All the research areas understudied were educational institutional that comes under silence zone and its prescribed limit is 50 dB(A) during daytime but observed results were above the limit around all the four areas. To mitigate the consequences of noise pollution, environmental aids such as effective rules and regulations, legislative implementation, barriers to transmission paths, social activities like awareness, motivation, and appreciation programs, and the support of mass media are necessary. Educational initiatives such as following noise ordinances and instructions, providing environmental education, and using noise-reducing teaching aids can help in creating a healthy and peaceful learning environment by reducing ambient noise levels.

Key Words :- Noise Pollution, Ambient Noise Level, CPCB, Sound Level Meter

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INTRODUCTION

The presence of excessive or unwanted sound in the environment is commonly referred to as sound pollution, or noise pollution. This can originate from various sources, including traffic, construction, industrial machinery, airplanes, loud music, and barking dogs. Sound pollution can have detrimental effects on human health and well-being, ranging from annoyance and distraction to serious health problems. Prolonged exposure to high noise levels can result in hearing loss, tinnitus, sleep disturbances, cardiovascular disease, and mental health issues such as anxiety and depression.

Noise pollution is a serious issue in India, which is often overlooked despite its significant impact on human health. While other pollutants such as exhaust fumes, oil spills, and land degradation are being addressed, noise pollution is often neglected. This is a growing concern, as noise pollution is becoming increasingly prevalent in urban areas. Many people find it challenging to live in noisy environments, which can lead to a variety of health problems. Unfortunately, people often view noise as a natural part of life and are unaware of the harm it can cause. Several common sources of noise pollution, including road traffic, aircraft, waste

collection vehicles, construction machinery, manufacturing operations, and lawn care equipment (Birgitta & Lindvall. 1995). All of these sources generate unwanted sounds that are regularly released into the environment. Numerous surveys, including those conducted by Alberola *et al.* 2005 & Bhosale *et al.* 2010, have addressed the issue of noise pollution in various cities around the world. These surveys have clearly demonstrated the extent to which noise can cause discomfort in people's lives, as noted by Vidyasagar & Rao, 2006. The effects of noise on human health and well-being are typically categorized into four groups based on the duration and intensity of exposure. These categories include physical effects such as hearing impairment, physiological effects such as elevated blood pressure and ulcers, psychological effects such as sleep disturbances, irritability, and stress, and effects on work performance such as decreased productivity and difficulty understanding speech, as identified by Evans & Hygge 2000.

An assessment of noise levels in the city of Kolhapur, Maharashtra, covering various zones such as Ambai square, University Road area, Rajarampuri area, Rankala lake, and New Palace area. The maximum Leq recorded was 63.71 dBA between 2.00-3.00 pm, while the minimum was 42.51 dBA during the night from 10.00-11.00 pm. The Leq observed in the educational zone during the daytime was found to exceed the prescribed CPCB limit of 50 dBA. The industrial-cum-residential zone had a noise level of 72.25 dBA, which is below the industrial limit but above the residential limit (Hunashal *et al.* 2012).

The noise pollution in Surat city and found that noise levels in educational areas varied from 112 to 118 dBA, much higher than the prescribed limit of pollution norms (Tandel & Macwan, 2011). A GIS-based assessment of noise pollution in Guwahati city and found that some commercial locations, such as Paltan Bazar, Guwahati Club, Ganeshguri, Khanapara, and Maligaon Charilali, had higher noise levels (more than 80 dB(A)) than other commercial places due to heavy traffic, narrow roads, and poor traffic management systems. Residential areas were also found to exceed the limits, and roadside residential areas crossed the level of 75 dBA (Alam, 2011). The noise level in Meerut city during the Deepawali festival and found that the noise level in residential area Shastri Nagar reached up to 85 dBA, which was higher than the commercial zone of Meerut (83 dBA). In the silence zones of the city, the noise level was around 70 dBA (Singh & Joshi 2010). The noise level in Moradabad city and found that the residential zones had noise level variations from 76 dBA to 102 dBA in the daytime and from 55 to 80 dBA in the night-time. The commercial zones had a much higher noise level of up to 105 dBA during the daytime, and the industrial zones had the highest noise level of 118 dBA. The silence zones of the city also exceeded the limit given in norms (Chauhan *et al.* 2010) .

According to Khaiwal, *et al.* 2016; Marathe, 2012; Garg & Maji, 2016; Subramani & Sivaraj 2012 and Pucher *et al.* 2005 almost all cities suffer from noise pollution, and big and unplanned cities have major problems with noise pollution. In unplanned cities, various small-scale industries, educational institutes, hospitals, and heavy traffic contribute to increasing noise levels. Despite the considerable amount of research conducted on different cities in limited information is available regarding Kolhapur specifically (Hunashal & Patil, 2011), current study focuses on Kolhapur city and provides a zone-based assessment and analysis of noise pollution indicators.

Governments and organizations like the World Health Organization have implemented several measures to address noise pollution, which is an inevitable part of modern life. Large cities and factories are primarily impacted by noise pollution, but even the constant hum of air conditioners and fans can contribute to the problem. The human ear can tolerate noise up to 85 dB without causing harm, but loud noises can cause lasting hearing damage. Noise pollution has been linked to a range of health issues, including high blood pressure, stress, and sleep difficulties. The impact of noise pollution on children's learning and performance has also been noted. The World Health Organization

has emphasized the short and long-term health risks associated with noise pollution. Although authorities have implemented restrictions on noise levels in certain areas, noise remains a challenge in many cities and schools. To mitigate noise levels, India has banned two types of gas engines. Other countries are also tackling the issue of noise pollution. As of 2016, 54.5% of the global population lived in cities, a figure expected to rise to 60% by 2030, making noise pollution an even more pressing concern.

Table 1- The permissible ambient noise level in different areas is indexed according to the Central Pollution Control Board (CPCB) of India.

Area	Permissible Noise Level (Daytime)	Permissible Noise Level (Night time)
Industrial	75 dB(A)	70 dB(A)
Commercial	65 dB(A)	55 dB(A)
Residential	55 dB(A)	45 dB(A)
Silence Zone	50 dB(A)	40 dB(A)

Note that the Silence Zone refers to areas such as hospitals, educational institutions, and courts, where noise levels should be kept to a minimum.

Study Area

A current survey and analysis of environmental noise pollution was conducted in the month of February and March 2023 in Ranchi, the capital city of Jharkhand. The estimated population of Ranchi city is currently 1,479,000. This city is considered as the citadel of education hub in Jharkhand. There are major reputed educational institutions of this state are there such as, Dr Shyama Prasad Mukherjee University (DSPMU), St. Xavier's College, Women's College and Marwari College etc. The Mentioned Colleges and university are taken into consideration for this research purpose because these institutions are in heavy traffic areas. Four major Educational Institutions of Ranchi were

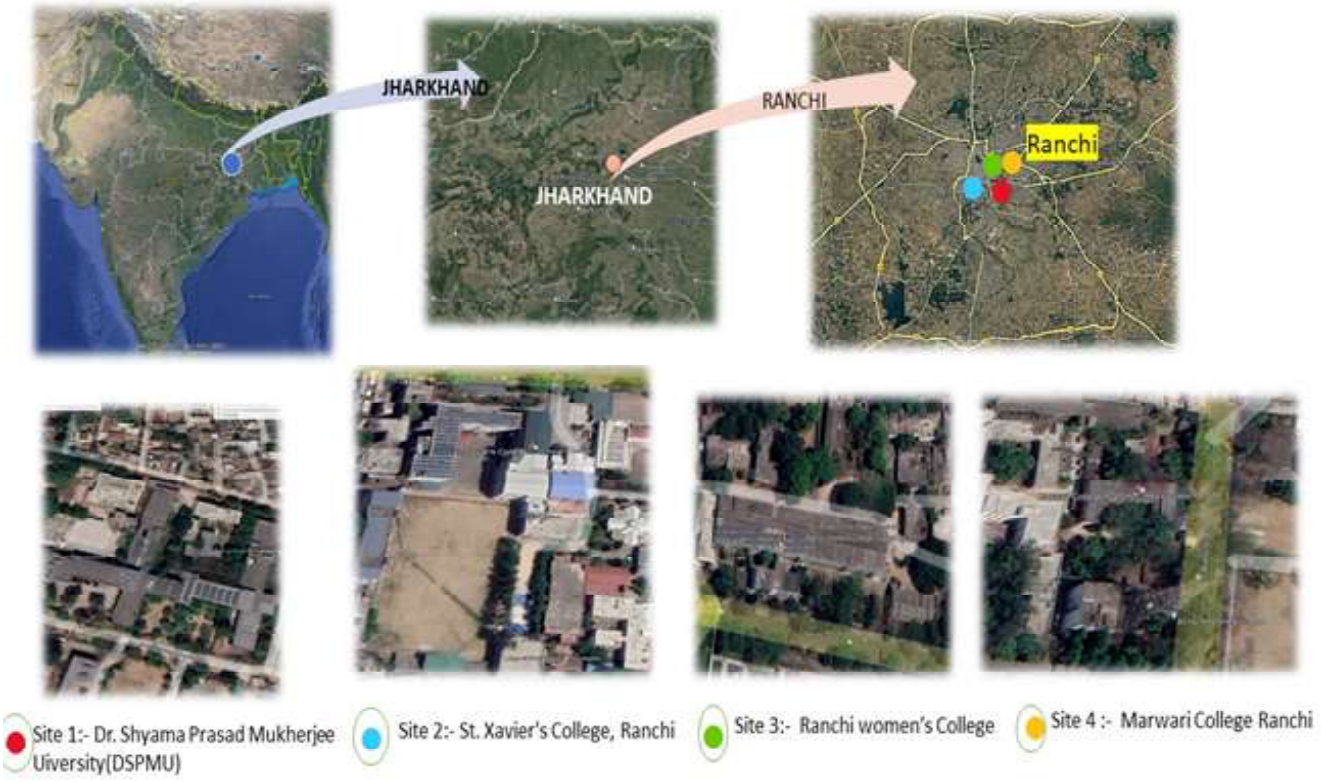

Figure 1: Map of the Educational Institutions understudied

selected for the measurement of the noise level. Site 1- Dr. Shyama Prasad Mukherjee University, located in Morabadi, Ranchi was founded in 1926 and popularly known as Ranch College. It was founded in 1960 as a division of Ranchi University. Site 2- St. Xavier College, Ranchi is an autonomous college affiliated with Ranch University. It is located in Ranchi, Jharkhand and was founded in 1944 and is considered as a busy urban residential area with markets, temples and Sadar hospital. Site 3- Women's College, Ranchi is an autonomous college affiliated with Ranchi University in Jharkhand, established in 1949. Located in a busy urban residential area on the circular road, Ranchi close to the SARNA compound, temple, Nucleus mall and public parks. Site 4- Marwari Boys College, Ranchi is an autonomous college founded in 1963 by the Marwari Sikhsha Trust. This prestigious college is in Jharkhand. Located in an urban residence close to the Daily Market and Swami Vivekananda Sarovar (Bada Talab) of Hindpidhi.

Measurement of Noise by Sound Level Meter

A sound level meter is a device (model SL-4001) that was used to measure the sound pressure level (SPL) in decibels (dB) in a specific environment. It typically consists of a microphone, amplifier, filter, and display unit. Here are the steps to perform a detailed study of noise measurement using a sound level meter:

1. Set up the sound level meter: First, ensure that the sound level meter is properly calibrated and set up according to the manufacturer's instructions. The microphone should be placed at the desired measurement location and at a height of 1.2-1.5 meters from the ground.

2. Measure the background noise: Before measuring the actual noise source, measure the background noise level at the same location to obtain a baseline reading. This is typically referred to as the "ambient" or "background" noise level.

3. Measure the noise source: Next, measure the noise level generated by the source of interest, such as traffic, machinery, or music. Make sure to measure the noise level at the same distance and height as the background noise level.

4. Calculate the difference between the two readings: Subtract the background noise level from the noise level generated by the source of interest to obtain the actual noise level. This is known as the "noise increment" or "noise level excess" and is typically measured in decibels.

The formula for calculating the noise level increment (NI) is: **NI = LAeq T - LAMB**

where LAeqT is the A-weighted equivalent sound level over a defined period (T), and LAMB is the A-weighted equivalent sound level of the ambient noise.

The A-weighting is used to account for the sensitivity of the human ear to different frequencies of sound. It is applied to the noise measurements to obtain a single value that represents the perceived loudness of the noise.

RESULT & DISCUSSION

The noise level findings evidenced that the noise pollution had affected millions of people daily. In this paper, noise pollution near the educational institutions and colleges of Ranchi i.e., Dr. Shyama Prasad Mukherjee University, St. Xavier College, Ranchi Women's College, and Marwari College. The study indicated that origin of noise around colleges and university premises were due to traffic cognization, domestic and automobile vehicle's noise along with the gathering of students before and after their classes etc.

To begin with, we needed to calculate the average noise levels for seven days at each institution at different times from 6.00 am morning to 6.00 pm evening on working days and holidays. We could then compare the average noise levels for each institution between working days and holidays to see if there were a significant difference.

Figure 2- Sound Level Meter (Model SL- 4001)

Table 2: Noise level (in dBA) in the four Institution of Ranchi during Regular Working Days

Institutions	TIME / DAYS	06:00 AM	08:00 AM	10:00 AM	12:00 AM	02:00 PM	04:00 PM	06:00 PM	Average
DSPMU	DAY 1	47.4	58.5	67.3	73.4	75.6	75.1	73	67.2
	DAY 2	45.3	50.6	66.1	72.9	67.1	56.2	50.5	58.3
	DAY 3	42.1	57.8	75.7	64.7	67.8	50.2	52.7	58.7
	DAY 4	43.4	55.9	71.9	67.8	71.7	51.6	50.9	59.0
	DAY 5	46.7	54.0	69.1	62.8	51.3	52.3	49.0	55.0
	DAY 6	48.9	52.6	67.3	71.2	69.7	55.1	51.6	59.4
	DAY 7	44.7	52.3	67.6	70.8	55.6	55.3	57.6	57.7
St. Xavier's College	DAY 1	47.8	61.1	73	72.7	70.2	77.3	74.7	69.7
	DAY 2	45.3	54.2	72.1	65.8	67.3	67.9	64.5	62.4
	DAY 3	43.1	59.7	59.1	64.5	58.3	70.8	58.3	58.6
	DAY 4	46.3	58.0	58.5	60.4	60.8	71.2	63.3	59.7
	DAY 5	40.1	57.1	62.7	58.4	67.8	76.2	56.4	59.1
	DAY 6	39.4	58.7	69.6	64.9	75.1	63.2	69.1	64.7
	DAY 7	42.1	56.6	63.4	75.3	74.4	70.3	53.7	61.2
Women's College	DAY 1	45.6	60.8	70.6	76.1	75.2	73.6	68.1	66.6
	DAY 2	44.3	53.2	63.2	65.3	70.1	68.1	61.2	60.7
	DAY 3	38.2	60.1	70.1	60.7	69.6	59.7	63.5	59.9
	DAY 4	45.6	55.8	63.5	64.3	68.1	61.7	58.4	59.1
	DAY 5	42.0	56.1	68.3	73.1	73.4	66.5	53.1	61.7
	DAY 6	40.6	53.2	74.5	77.5	75.5	69.0	67.6	65.4
	DAY 7	43.4	61.2	67.2	70.1	67.9	64.1	62.3	62.3
Marwari College	DAY 1	48.9	67.2	71.5	73.4	76.3	73.1	70.2	69.3
	DAY 2	45.1	60.6	64.0	69.3	71.2	72.1	64.7	63.8
	DAY 3	39.7	63.5	70.1	71.3	68.3	66.7	68.1	63.9
	DAY 4	42.1	53.1	73.4	70.6	71.2	68.1	72.1	64.3
	DAY 5	47.5	58.1	78.7	68.7	75.6	67.6	68.9	66.4
	DAY 6	42.3	68.2	64.3	66.7	77.3	69.0	62.1	64.2
	DAY 7	40.2	63.6	64.0	65.7	68.7	61.2	63.2	60.9

The noise levels (in dBA) for each institution measured at different times on the working day

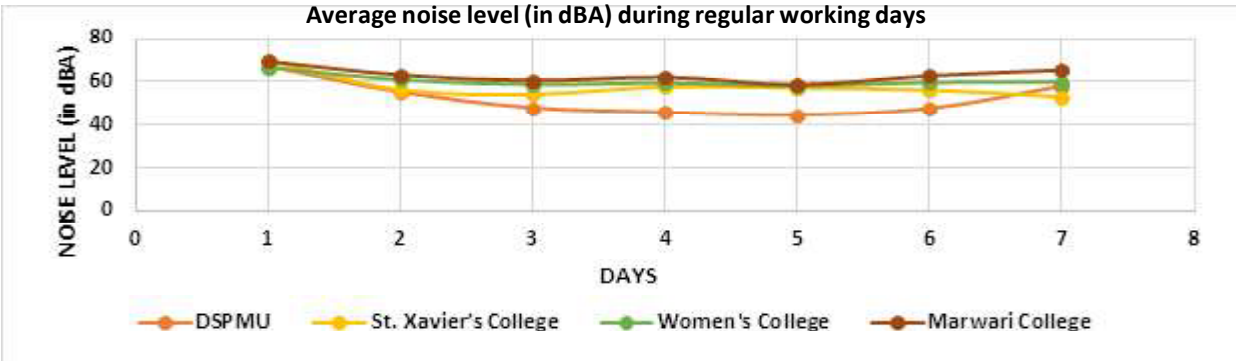

Figure 3: Graphical representation of Average Nosie Level (in dBA) of regular working days

Table 3: Noise level (in dBA) in the four Institutions of Ranchi during Holidays

Institutions	TIME / DAYS	06:00 AM	08:00 AM	10:00 AM	12:00 AM	02:00 PM	04:00 PM	06:00 PM	Average
DSPMU	DAY 1	47.4	58.5	67.3	73.4	75.6	75.1	73	67.2
	DAY 2	46.3	55.3	57.7	56.8	58.1	57.2	56.6	55.4
	DAY 3	44.1	49.7	50.2	47.3	48.7	51.0	46.2	48.1
	DAY 4	46.8	50.0	46.5	45.9	46.2	43.9	43.3	46.0
	DAY 5	42.2	46.6	39.5	44.4	57.5	41.3	42.4	44.8
	DAY 6	45.0	43.6	46.6	45.5	49.8	44.4	59.9	47.8
	DAY 7	41.3	51.9	58.9	66.5	60.0	67.1	61.4	58.1
St. Xavier's College	DAY 1	47.8	61.1	73	72.7	70.2	77.3	74.7	69.7
	DAY 2	43.1	56.6	63.0	59.3	60.2	57.2	55.1	56.3
	DAY 3	38.9	53.5	52.3	60.8	68.6	54.3	52.3	54.3
	DAY 4	50.2	51.6	56.8	68.9	67.7	54.1	54.7	57.7
	DAY 5	40.7	56.6	61.9	61.3	60.4	58.9	60.0	57.2
	DAY 6	41.3	58.0	59.6	58.1	59.3	61.2	56.2	56.2
	DAY 7	47.8	55.4	57.1	52.4	51.2	56.3	51.7	53.1
Women's College	DAY 1	45.6	60.8	70.6	76.1	75.2	73.6	68.1	66.6
	DAY 2	41.4	52.0	69.9	62.5	67.2	69.3	64.2	60.9
	DAY 3	43.2	51.3	61.1	57.2	58.8	71.2	68.9	58.8
	DAY 4	38.7	56.5	60.5	76.3	53.1	60.3	70.8	59.4
	DAY 5	40.7	48.5	62.6	61.2	60.1	69.3	64.3	58.1
	DAY 6	43.1	52.7	65.0	57.3	64.2	70.1	65.7	59.7
	DAY 7	39.1	58.6	58.9	66.0	73.4	62.3	60.4	59.8
Marwari College	DAY 1	48.9	67.2	71.5	73.4	76.3	73.1	70.2	69.3
	DAY 2	35.7	59.1	63.1	73.1	70.0	71.4	69.3	63.1
	DAY 3	42.6	52.9	60.4	68.2	69.8	69.3	60.5	60.5
	DAY 4	49.4	51.7	73.2	71.2	64.3	64.1	61.3	62.1
	DAY 5	39.4	52.6	63.1	59.0	66.7	65.6	65.1	58.7
	DAY 6	43.4	54.4	65.6	65.6	73.1	70.3	66.7	62.7
	DAY 7	43.8	51.9	73.1	74.4	72.7	68.7	73.1	65.3

The noise levels (in dBA) for each institution measured at different times on holidays

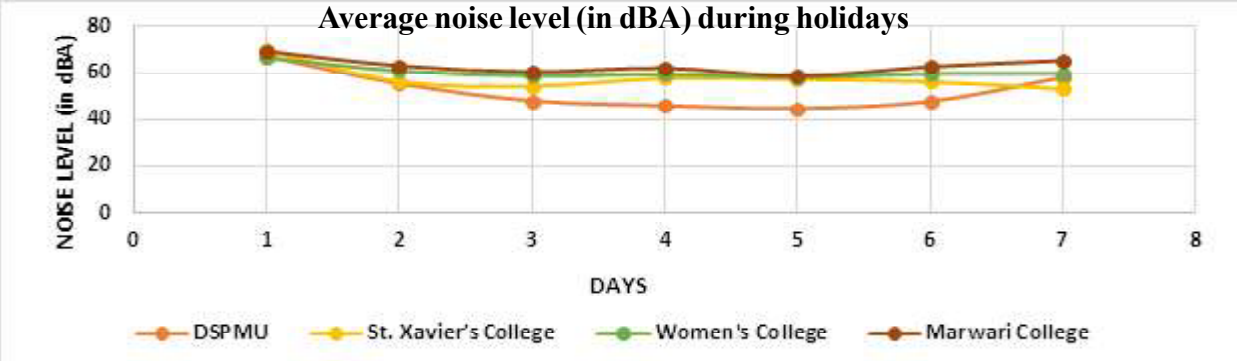

Figure 4: Graphical representation of Average Nosie Level (in dBA) of holidays

From the above tables and graphs we observed that the noise levels were generally higher on working day as compared to holiday. This could be due to the increased human activity and vehicular movement on working days.

Additionally, we also observed that the noise levels vary across institutions, with some institutions having consistently higher noise levels than others. For example, DSPMU and St. Xavier had higher noise levels than Women's College and Marwari College.

In conclusion, based on the data provided, we can say that the noise levels are generally higher on working days as compared to holidays, and the noise levels vary.

The two tables provided in the question show the average noise levels measured at different times of the day for four different institutions on both regular working day and holiday. The data could be analysed to determine if there were a difference in noise levels between working day and holiday, and if there were variations in noise levels between the different institutions.

When we compared the two tables showing noise levels, one for regular working days and the other for regular holidays, we observed some differences in the noise levels measured.

Firstly, the noise levels were generally higher on working day compared to holiday. This difference can be seen across all institutions in different times of the day, with the exception of a few instances where the noise levels are higher on holidays, such as at Women's College at 10:00 AM.

Secondly, there were variations in noise levels between different institutions. On both working day and holiday, DSPMU and St. Xavier generally had higher noise levels compared to Women's College and Marwari College. However, there are some exceptions, such as at Marwari College at 2:00 AM on working days where the noise level is higher than at DSPMU and St. Xavier.

Lastly, we could also observe variations in noise levels at different times of the day. For instance, on working day, the noise levels at all institutions were highest between 12:00 PM and 2:00 PM. However, on holiday, there was no consistent peak in noise levels at any particular time, although some institutions had higher noise levels in the morning.

Overall, the two tables demonstrated that noise levels would vary depending on the day of the week and the time of the day, and also that different institutions might have different levels of noise pollution. These differences were due to a variety of factors, such as the number of people or vehicles in the area, or the type of activities taking place. Understanding these variations in noise levels could help in implementing strategies to reduce noise pollution and promote public health and safety.

CONCLUSION

The result showed that all the 4 colleges and university were under influence of background noise around their premises. The noise levels were measured on working as well as non-working day to estimate the difference in noise level. The noise captured during working day is much more than non-working day. The data that were collected from all the colleges and university in the month of February for a whole working day and a holiday from 6.00 am to 6.00 pm at the 2 hrs of time interval. It was than compared according to CPCB norms for ambient noise level in silence zone that the noise level was more near the campus of Marwari College in comparison to St. Xavier's College, Ranchi Women's College and DSPMU. Even though St. Xavier College, Women's College and DSPMU was near the main road with high traffic and exposure of noise. The infrastructure, tree cover, well developed parking lot, sound proof lecture rooms and lab played an important role in noise reduction within college campus helping students in increasing their performance level. While Marwari College even is in the outskirts of traffic area the acquired result is shocking as the means ambient level is noise is higher than the standard of noise. As per the Indian standard the desirable noise pollution for the educational sectors and hospital during the day should not exceed over 50dBA. But primary data collected showed that throughout the 4 colleges in Ranchi city had exceed the ambient

level. It was basically happened between 10 am to 12:00 pm and 3:00pm to 5:00 pm. During this time duration maximum noise exposure was captured.

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