ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 8, 2022

ASSESSMENT OF TRAFFIC NOISE IN THE YOGA CAPITAL OF UTTARAKHAND- INDIA

Hira Lal, Yadav,[1] Krishna Nand,[1] Riddhi Bhurji,[1] RAJNI[1] and Janhvi Yadav[2]

[1]Department of Civil Engineering, G.B. Pant Institute of Engineering and Technology, India.

[2]Department of Civil Engineering, MNNIT, Allahabad , India.

Corresponding author: hiralalyd@gmail.com.

ABSTRACT

A study has been made to assess the noise pollution at thirty different locations in yoga city Rishikesh, which is lies between Latitude 30° 06' 12.12" N and 27°29′N and Longitude 78° 17' 41.11" E. During each sampling of noise, 25readings of SPL were recorded at an interval of 30 seconds in a period of 10 minutes from 5 January 2021 to 30 January 2021 for the parameters such as L_{10}, L_{50}, L_{90}, Lmax, and Lmin in addition to Leq in different categorized vicinity. The results revealed that minimum and maximum pollution of noise levels varied between 56.1 to 83.6 dB (A) Leq. in the city. Based on the questionnaire survey, 70% of respondents reported headache, 90% sleeplessness, 48% hypertension, 75% stress, 80% irritation, and Before and after the lockdown period, respectively, (60%) and (82%) of respondents reported feeling no disturbance due to noise. Higher Noise level produces direct and cumulative inauspicious effects on the health of existing population and animal and it also humiliate suburban, societal and working environment with consequent real and insubstantial losses. The noisy environment also rises as one of the crucial poisons of circumstance. From researches noise pollution is a globally major problem including India. Noise level in the study area is found higher than the standard limits prescribed by CPCB. The present assessment will be key for the awareness of the public and authorities to take any action to control noise pollution and protect society from its unfavorable effects.

Keywords: Equivalent continuous noise level (Leq), Noise pollution, Noise pollution indices, Noise standards, Traffic noise and Questionnaire.

INTRODUCTION

The rapid increase in the populations of the urban and suburban areas all over the world has resulted in the extension of cities vicinity which is necessary for providing appropriate jobs, housing, and sustainable livelihoods (Basu et al., 2021). Pollution is the addition of unwanted substances into the environment that can damage our earth. Noise is generally defined as the unwanted sound produced by various natural or man-made sources such as construction, industrial, transportation activities, etc. Present time anthropogenic activities are the major source of noise pollution (Templeton et al. 2016). Noise associated with the transportation sector is a worldwide problem, which has allied with the industrial revolution (Caciari et al. 2013). The unpleasant sounds and noise become unwanted when it interferes with normal activities such as sleep or conversation, disrupts or diminishes one's quality of life, and an imbalance in nature. Noise pollution is the consequence of worldwide urbanization and industrialization and it is

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 8, 2022

considerably dissimilar from air, soil, and water pollution due to its extensive and exclusive sources. Nowadays it is considered a major environmental problem in developed and developing countries all over the world including India also (Ravindra et al. 2016). Many studies all over the world support the connection between environmental noise and human and animal health. The World Health Organization says that any sound less than 70 decibels is not hazardous and will not cause any ill effects to the living organisms. However, sounds that are more than 70 decibels are considered hazardous. Poor urban planning may give rise to noise disintegration or pollution, side-by-side industrial and residential buildings can result in noise pollution in the residential areas. The main sources of noise pollution in urban area which affect the modern life of a human is transportation sector like roadway (Cai et al. 2019), railway (Bunn and Paulo 2016; Pultznerova et al. 2019), airway and airport (Gagliardi et al. 2017), and the very irritating noise of wind turbine (Gallo et al. 2016; Michaud et al. 2016). Internationally Noise pollution is the main issue of environmental complaints in many large cities of India. This has noteworthy impacts on the quality of human wellbeing (Dzhambov et al. 2017; Gozalo et al. 2018). Many studies were done by researchers in the different parts of the country also support the relationship between human health and environmental noise.. A higher level of noise exposure is able to cause a number of troubles associated with human health, such as slumber disorders with arouse and mental health disorders (Sygna et al. 2014), obliteration in learning, hypertension ischemic heart sickness (Eunice et al. 2014), issues of high blood pressure (Evans et al. 2001), loss of memory (Paunovic et al. 2011), reductions in spur and attention (Matheson et al. 2010), mainly irritation harming physiological functions in humans and its effects are also seen in animals, noise can enhance the risk of death by altering predator or prey detection and avoidance, interfere with reproduction and navigation, and contribute to permanent hearing loss. The allowable noise level for different zones is laid down by Central Pollution Control Board (CPCB). However, many locations in the study area are at this time facing many challenges, among which is a rising noise pollution level. As more and more villagers and children move down to the plains of Uttrakhand to seek economic opportunity as well as access to the basic facilities and infrastructure. Thus, cities are becoming overcrowded. This paper aims to study the growing noise level trends in the city, analyze the sound levels to ascertain the status of ambient noise levels, and recommend appropriate protective measures. The data used for substantiation has been observed with the help of a sound meter at various locations in yoga capital Rishikesh and then this obtained data were compared with the ambient standards prescribed by CPCB. These days, a lot of researchers from all over the world in different fields are Paying Attention to the assessment of environmental noise from the commercial, residential, silent, and industrial area which is affected by noise levels (Minichilli et al. 2018; Wang et al. 2018; WHO, 2018). A study done by (Kim et al., 2019) suggests that an increase of 5dB of roadside noise can raise the probability of hypertension by 3.4%.

Location of the study area

The present study was conducted before and during the COVID-19 lockdown, 2021 with the help of portable precision sound level meter type SL-4005 to examine the ambient noise levels of yoga capital of Uttarakhand, India. The study area is situated at latitude 30.103368°N and longitude 78.294754°E with an average elevation of 340 meters (UTM, 2021) with a heavy density of population of 8851/km^2. The city is also known as the "Gateway to the Garhwal Himalayas" and "Yoga Capital of the World" (Fig.1). In the study area a number of prehistoric and new temples, are also located such as Shatrughna Mandir, Bharat Mandir (Lord Vishnu's avatar), Lakshman Mandir, and Lakshman Mandir is situated near Lakshman Jhula.

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 8, 2022

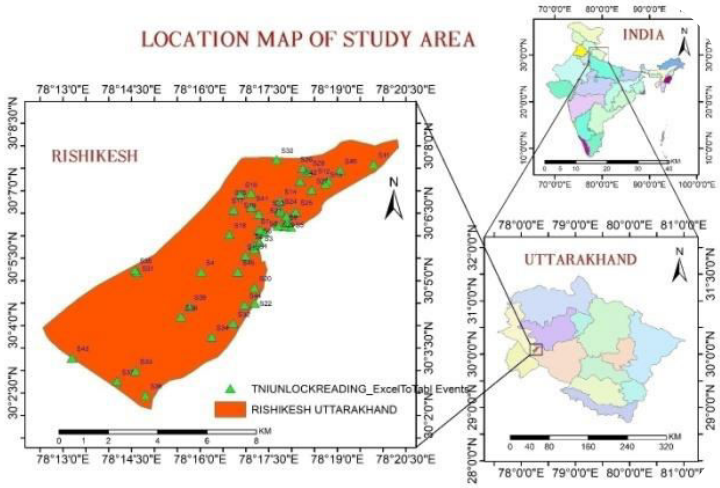


Fig. 1: Sampling locations of Rishikesh City.

Materials and Method

For the monitoring of noise level, a sound pressure level meter was used. The sampling of noise level is based on the recommendation of CPCB and the instruction manual of the instrument. To assess the representative noise monitoring, thirty sampling locations (shown in fig.1) were chosen at a different locations in the study area to assess the subjective and objective noise levels from 2 January 2021 over from 15Februry 2021. For assessing noise level, the sound level meter was placed 1.2 m above the ground level and 3.5 m far from the noise source to assess the noise from all sampling locations (Farooqi et al. 2017). The subjective assessment has been conducted through the question answer survey by involving people residing around the selected noise monitoring stations where readings have been taken.

The observations of the parameters such as L10, L90, L50, Lmax, and Lmin in addition to Leq were carried out at the 30 designated monitoring stations which are shown in study area map (Fig. 1). The sound pressure level at each station was noted two times a day i.e. in the Morning (6 am-10 am) and in the Evening (4 pm -10 pm). This imparts a holistic picture of Noise Climate (NC), Noise Pollution Level (Lnp), and Equivalent Continuous Noise Level (Leq). The observed values and deduced values of NC, Lnp, and TNI (Traffic Noise Index) are shown in special distribution map.The value of NC is also shown in Fig. 4. Since the observed values are in decibels hence cannot be averaged out, therefore, critical parameters have been worked out separately for each station.

The following formulae have been deployed NC (Noise Climate) = $L_{10} - L_{90}$

L_{np} (Noise Pollution Level) = $L_{50} + [NC^2/56] + NC$

TNI (Traffic Noise Index) = $L_{90} + 4\,[L_{10} - L_{90}] - 30$

RESULTS AND DISCUSSION

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 8, 2022

The summary of noise monitoring results obtained different some countries and organization including India are given in Table 1.

Table1. Ambient Noise level standard of some countries and organization

Countries / Organization	Noise level in dB(A)							
	Silent zone		Residential Area		Commercial Area		Industrial Area	
	Day	Night	Day	Night	Day	Night	Day	Night
Australia	45	35	45	35	55	45	65	55
Bangladesh	45	35	50	40	70	60	75	70
India	50	40	55	45	65	55	75	70
Iran	N/A	N/A	55	45	65	55	75	65
Japan	45	35	50	40	60	50	60	50
Malaysia	50	40	60	50	65	55	75	70
Nepal	50	40	55	45	65	55	75	70

Source: (CPCB, 2001;Yadav et al., 2021)

The value of Leq noise level before and after lockdown period ranged from 63.6 to 69.9 dB (A) and 56.2 to 66.0 dB (A) respectively its special distribution shown in (Fig. 2).

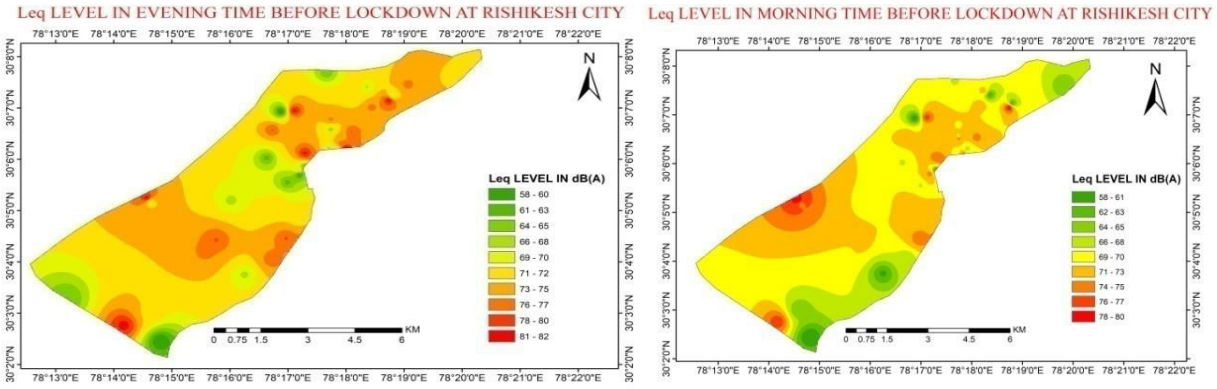


Figure 2: Spatial distribution of (Leq) Noise level during lockdown at Morning and Evening time

In the morning time maximum noise level of 120.24dB (A) was recorded at Chungi (S_8) and a minimum noise level of 63.91 dB (A) was recorded at Geeta Bhawan (S12). Noise Climate (NC) represents the range over which the sound levels fluctuate in the given time interval. Station (S_8) Chungi represents the highest fluctuation with the NC levels of 22.66 during the morning. Station (S_{28})Vithal Ashram has registered the lowest fluctuation owing to the relative stability of noise sources during the morning. From the above Figure, it was determined that in the Evening time maximum noise level of 107.36dB (A) was recorded at Mandi (S_1), followed by Sai Ghat (S_3) with a maximum reading of 103.46dB (A) and a minimum noise level of 63.01 dB (A) was recorded at Tehsil (S_{16}). Further, determined Leq of selected stations of both Morning and Evening was then compared with Lcpcb through the help of bar charts as shown in Fig. 5 and Fig. 6 respectively. Station 1 Mandi represents the highest fluctuation with the NC

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 8, 2022

levels of 21.62 during the evening. Station (S_{16}) Tehsil has registered the lowest fluctuation owing to the relative stability of noise sources during the evening period.

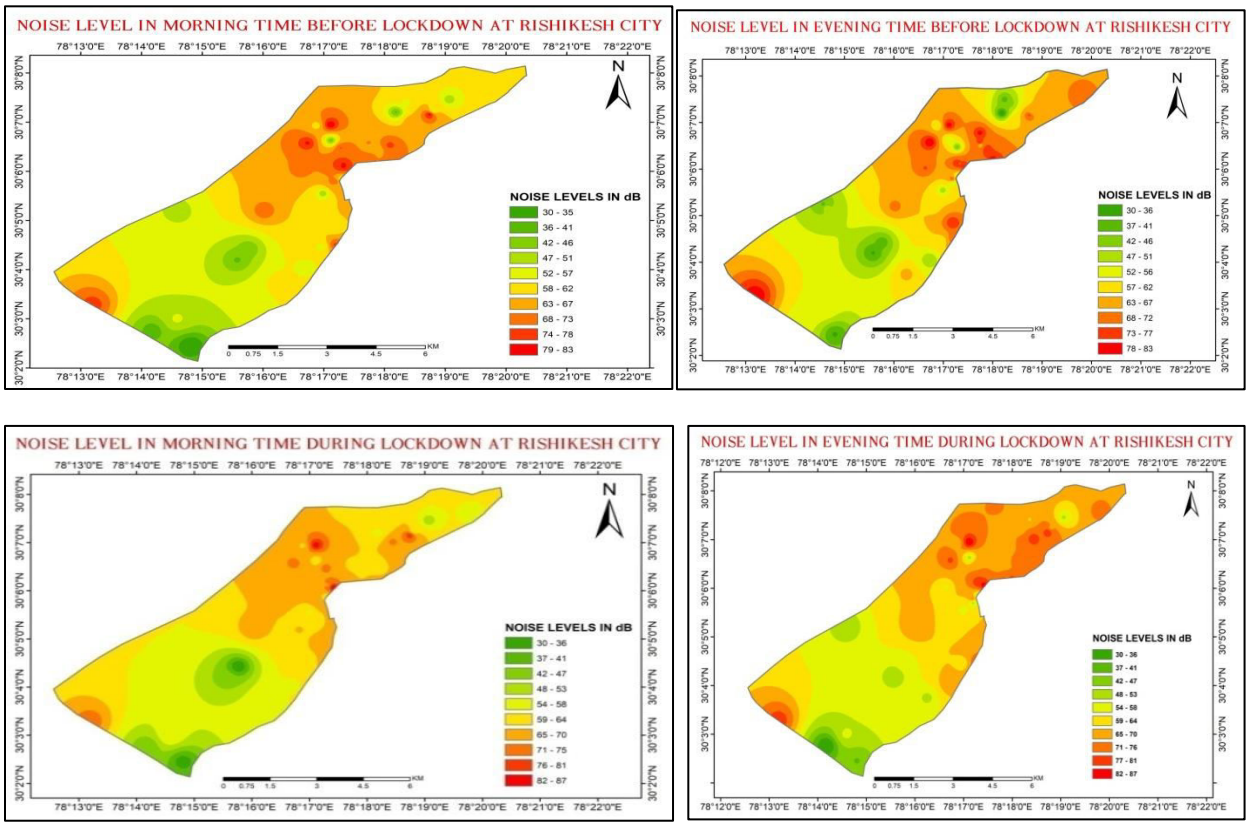


Figure 3: Spatial distribution of Noise level during lockdown at Morning and Evening time

The Spatial distribution of Noise Climate (NC) is shown in Figure 4 for before lockdown and after lockdown. Noise Climate (NC) provides an illustration of the range of sound level variation over the specified time period. Station (S_8) Chungi exhibits excessive variation with the NC levels of 22.66 during the morning. The lowest Noise Climate (NC) was recorded at Parmarath Ashram during evening period. The variation was found in the very close range in the whole area.

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 8, 2022

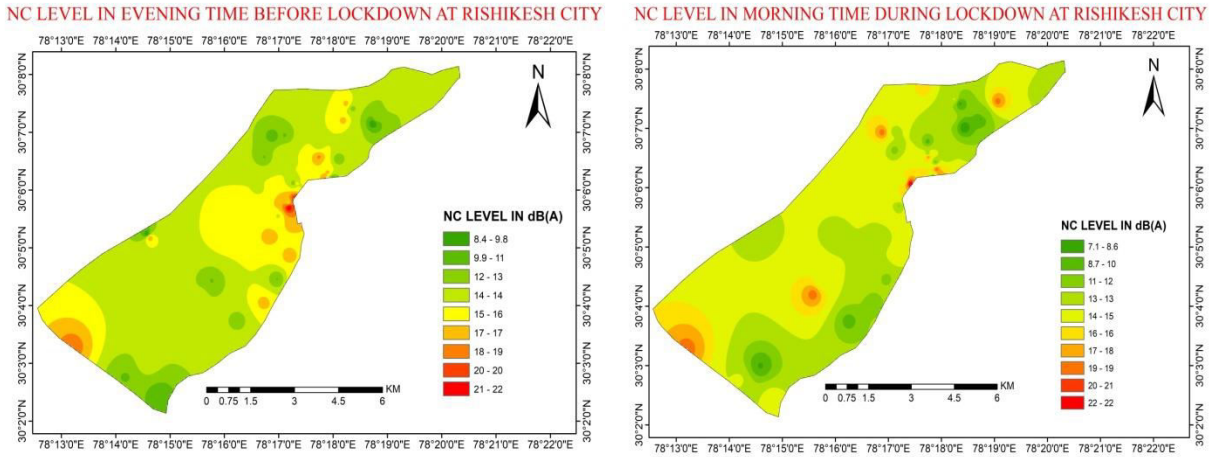
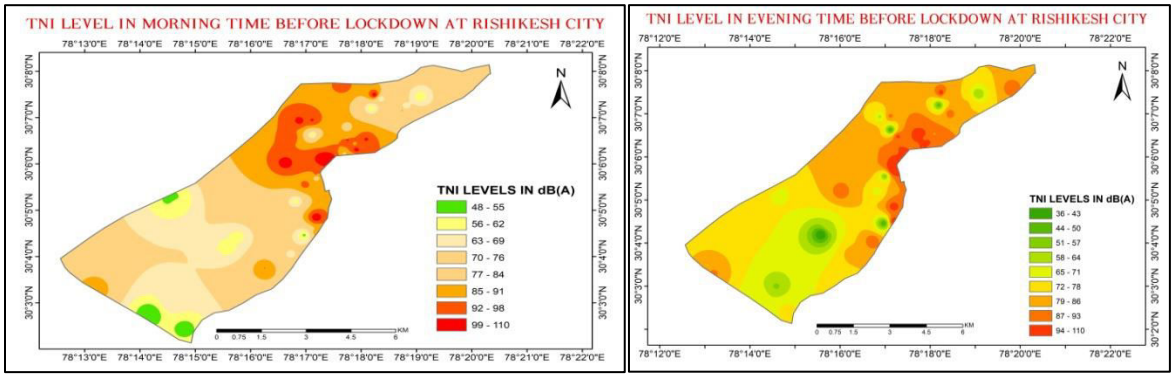


Figure 4: Spatial distribution of NC level during lockdown at Morning and Evening time

The values of traffic noise index (TNI) noted in the study area were found higher than the limit of 53 dB(A) suggested by WHO (2018). The calculated value shown in shown in Fig.5 indicates that the Traffic Noise Index (TNI) which is a technique used for the estimation of the annoyance responses due to traffic noise, it's value was found 63.01 dB(A) to 107.36 dB(A), and 70.09 to 119.45 dB(A) respectively before lock down and during partially lock down ,the maximum value of TNI was obtained 119.45 dB(A) at Chungi and the minimum TNI value was recorded 63.01 at Tehseel. The comparison between Leq and Lcpcb are also shown in Fig. 1 and Fig.2 before lockdown and during lock down period.The traffic noise index (TNI) and Noise Climate (NC) are directly associated with each other. When the value of (TNI) increases then the value of (NC) also increases.

The maximum value of LNP was found in the range of 68.22 to 97.57dB (A) and 71.61 to 96.9157dB (A) correspondingly before lockdown and during lock down period Further, determined Leq of selected stations of both Morning and Evening shown in Fig. 6 respectively. Station 1 Mandi registered the highest variation with NC levels of 22.62 during the evening period. The lowest fluctuations have been found at monitoring station Vithal Ashram evening period.



ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 8, 2022

Figure 5: Spatial distribution of TNI level before lockdown at Morning and Evening time

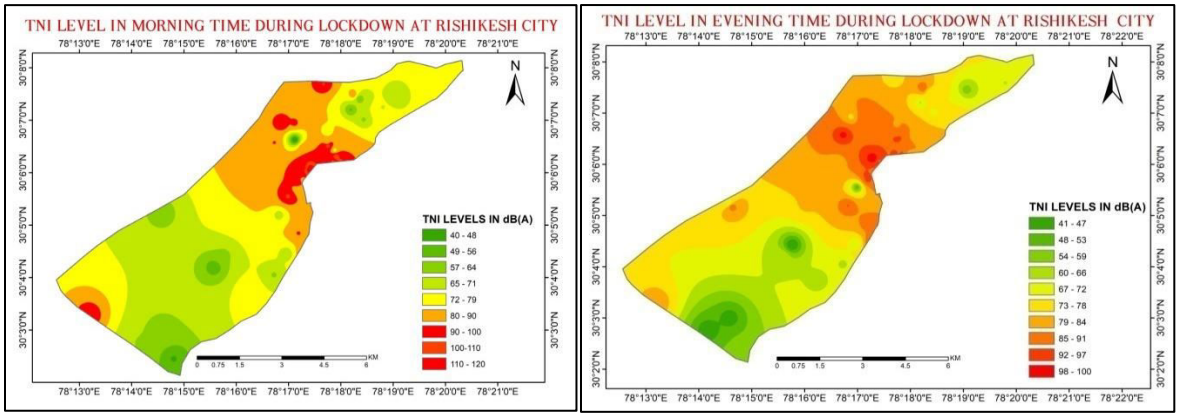


Figure 5: Spatial distribution of TNI level during lockdown at Morning and Evening time

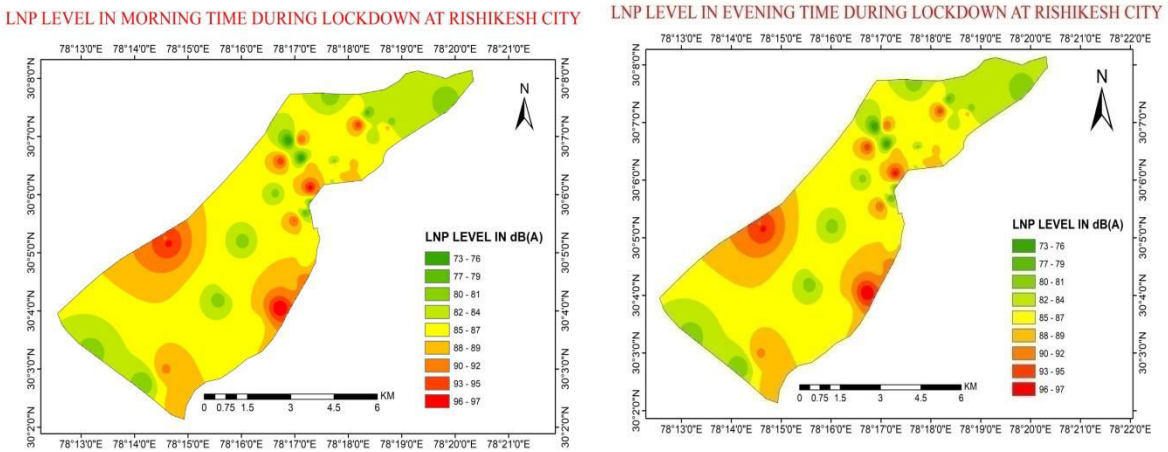


Figure 6: Spatial distribution of LNP level during lockdown at Morning and Evening time

Impact of noise pollution on human health

A public health survey based on question answering was conducted among 150 local inhabitants whose ages ranged from 18 to 85 years. The results of the current study showed that noise levels in the city have risen to disturbing levels. The survey's findings (Fig.7 and Fig.8) showed that 90% of respondents reported feeling anxious due to increased traffic noise, and about 85% of inhabitants said that traffic noise is the primary cause of annoyance, headache (70%), loss of sleep (90%), hypertension (48%) and stress (75%) before lockdown after lockdown period. However, the survey also found that impacts of noise pollution on human health were very low, including annoyance (30%), headache (35%), sleep disturbance (20%), Stress (28%) and hypertension (38%) occurred during the lockdown. Before and after the lockdown period, respectively, (60%) and (82%) of respondents reported feeling no disturbance during

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 8, 2022

the research period. Higher educated and wealthier people are far more conscious of the harm that traffic noise does to their health. Due to increased noise levels, marital status was also severely disrupted.

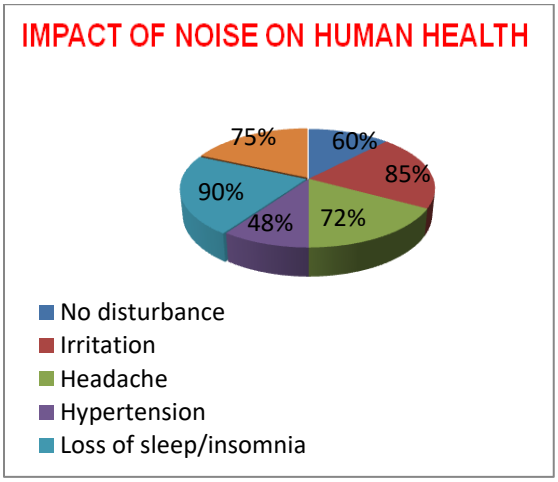


Fig. 7: Impact of noise on human health before lock down

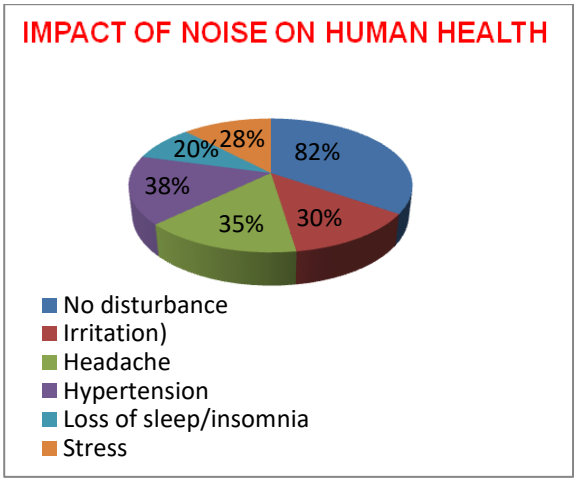


Fig. 8: Impact of noise on human health after lock down

Table 2. Relative summary of noise pollution monitoring and its related health risks

Study area	Results	Key findings	References
Australia	Annoyance, irritation	≥ 68 dB	Munro et al. 2018
India	Hypertension, hearing annoyance, high blood pressure, headache, troubles in sleeping , wooziness, etc.	> 102 dB	This study
India	Injure to eardrum	≥ 80 dB	Patel et al. 2015
India	harm to eardrum, difficulty in sleeping	80 dB	Bano et al. 2018
London	Hypertension, Angina, diabetes, etc.	≥ 60 and ≥ 65 dB	Tonne et al. 2016
New York city	Hearing troubles	≥ 76 dB	Olson 2018
Ota, Nigeria	Hypertension, hearing disturbance, high blood pressure, etc.	> 65 dB at day and >55 dB	Usikalu and olawole 2018
Pakistan	Hypertension, hearing disturbance, high blood pressure, nuisance, sleep disturbances, faintness, etc.	> 101 dB	Farooqi et al. 2019
Turkey	Nervous frailty, anxiety, dizziness, etc.	≥ 65 dB	Ozer et al. 2009

CONCLUSION

The present assessment was the attempt to study the impacts of sound levels. The obtained result in the study area are crossing the prescribed limits of CPCB, and the recorded noise levels range from 60 dB(A)(min) to above 102 dB(A)(max.). Due to the high noise level in the study area, populaces are suffering from many health-associated diseases such as annoyance, high blood pressure, hopelessness,

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 8, 2022

and wooziness, and headache, loss of sleep. Present time noise pollution in the study area affects the human health and natural environment of the city. To control the impact of noise, comprehensive programs are required to educate the populace about the success and effectiveness of measures that would decrease urban traffic noise and save from harm the public from its unnecessary impacts.

Acknowledgement: Authors are thankful to director and head of department of civil engineering to provide facility for conducting the noise level survey.

References

1. Bano N, Ahmad A, Shamim SK (2018). Environmental impact assessment of noise quality: a health based study of Firozabad City (India).The Geograph 65(1):1-9.
2. Basu, B., Murphy, E., Molter, A., Sarkar A., Basu, Sannigrahi, S., Belmonte, M. et al. Investigating changes in noise pollution due to the COVID-19 lockdown: the case of Dublin, Ireland. Sustain Cities Society, 65 (2021), p. 102597
3. Caciari T, Rosati MV, Casale T, Loreti B, Sancini A, Riservato R, Nieto HA, Frati P, Tomei F, Tomei G (2013).Noise-induced hearing loss in workers exposed to urban stressors. Sci Total Environ 463-464:302-308
4. Cai M, Lan ZQ, Zhang ZW, Wang HB (2019). Evaluation of road traffic noise exposure based on high-resolution population distribution and grid-level noise data. Build Environ 147:211-220.
5. CPCB, 2001: Parivesh Highlights (2000). Central Pollution Control Board, East Arjun Nagar, NewDelhi. pp. 18. Edison,
6. Dzhambov A, Tilov B, Markevych I, Dimitrova D (2017). Residential road traffic noise and general mental health in youth: the role of noise annoyance, neighborhood restorative quality, physical activity, and social cohesion as potential mediators. Environ Int 109:1
7. Eunice YL, Michael J, Zev R, Patricia FC, Edmund YWS (2014). Assessment of traffic-related noise in three cities in the United States. Environ Res 132:182-189.
8. Evans GW, Lercher P, Meis M, Ising H, Kofler WW (2001). Community noise exposure and stress in children. J Acoust Soc Am 109(3): 1023-1027.
9. Farooqi ZUR, Nasir MS, Nasir A, Zeeshan N, Ayub I, Rashid H, Qamar MU, Sarwar A, Akram M.A. (2017) Evaluation and analysis of traffic noise in different zones of Faisalabad–an industrial city of Pakistan.Geol Ecol Landscapes 1(4):232-240.
10. Farooqi ZUR, Sabir M, Latif J, Aslam Z, Ahmad HR, Ahmad I, Imran M, Ilić P. Assessment of noise pollution and its effects on human health in industrial hub of Pakistan. Environ Sci Pollut Res Int. 2020 Jan;27(3):2819-2828.
11. Gagliardi P, Fredianelli L, Simonetti D, Licitra G (2017). ADS-B system as a useful tool for testing and redrawing noise management strategies at Pisa airport. Acta Acust Acust 103(4):543-551(9).
12. Gallo P, Fredianelli L, Palazzuoli D, Licitra G, Fidecaro F (2016). A procedure for the assessment of wind turbine noise. Appl Acoust 114:213-217.
13. Gozalo GR, Morillas JMB, González DM, Moraga PA (2018). Relationship among satisfaction, noise perception, and use of urban green spaces. Sci Total Environ 624:438-450.
14. Kim, K., Shin, J., Oh, M. and Jung, J.K., 2019. Economic value of traffic noise reduction depending on residents' annoyance level. Environmental Science and Pollution Research, 26(7), pp.7243-7255.

ISSN PRINT 2319 1775 Online 2320 7876

Research paper UGC CARE Listed (Group -I) Journal Volume 11, Iss 8, 2022

15. Matheson M, Clark C, Martin R, van Kempen E, Haines M, Barrio IL, Hygge S, Stansfeld S. (2010).The effects of road traffic and aircraft noise exposure on children's episodic memory: The RANCH Project. Noise Health; 12(49):244-54.
16. Minichilli, F., Gorini, F., Ascari, E., Bianchi, F., Coi, A., Fredianelli, L., et al. (2018). Annoyance judgment and measurements of environmental noise: a focus on Italian secondary schools. Int. J. Environ. Res. Public Health 15:208. doi: 10.3390/ijerph15020208.
17. Munro J, Williamson I, Fuller S (2018).Traffic noise impacts on urban forest soundscapes in South-Eastern Australia. Aust Ecol 43(2):180-190
18. Olson TTC (2018) Effects of ambient noise on sleep in New York City. J Transp Health 9:S15.
19. Ozer S, Yilmaz H, Yeşil M, Yeşil P (2009). Evaluation of noise pollution caused by vehicles in the city of Tokat, Turkey. Sci Res Essays 4(11):1205-1212.
20. Patel KB, Chaudhari SA, Goravadiya VP (2015).Noise pollution in Vadodara city-a case study. Development 2(9):1-10.
21. Paunovic K, Belojevic G, Jakovljevic B (2013). Blood pressure of urban school children in relation to road-traffic noise, traffic density and presence of public transport. Noise Health 15:253–260
22. Ravindra Khaiwal, Singh Tanbir , Tripathy, Jaya Prasad, Mor, Suman , Munjal Sanjay, Patro Binod, Panda Naresh (2016). Assessment of noise pollution in and around a sensitive zone in North India and its non-auditory impacts.Science of the Total Environment 566-567 pp. 981-987.
23. Sygna, Karin, Gunn Marit Aasvang, Geir Aamodt, Bente Oftedal, and Norun Hjertager Krog. (2014). “Road Traffic Noise, Sleep and Mental Health.” Environmental Research. https://doi.org/10.1016/j.envres.2014.02.010.
24. Templeton, Christopher N., ZollingerSue Anne, Brumm Henrik (2018).Traffic noise drowns out great tit), Current Biology, pp.1173-1174.
25. Tonne C,Milà C, Fecht D, AlvarezM, Gulliver J, Smith J, Kelly F (2016). Socioeconomic and ethnic inequalities in exposure to air and noisepollution in London. Environ Int 115:170-179.
26. Usikalu M.R and Kolawole O (2018). Assessment of noise pollution in selected locations in Ota, Nigeria. International Journal of Civil Engineering and Technology 9(9):1212-1218.
27. Wang Haibo, Wub, Zeyu, Chen Jincai, Chen, Liang (2022).Evaluation of road traffic noise exposure considering differential crowd characteristics.Transportation Research Part D: Transport and Environment ,105, 103250
28. WHO (2018). Environmental Noise Guidelines for the European Region. WHO Regional Office for Europe UN City, Denmark, 19-21.
29. Yadav, Hira Lal, Yadav, J. Kohli, Sonali, Garima and Rajni (2022). Assessment and Analysis of Traffic Noise in different zones of Haridwar -A Historical City of India. IJRAR 9(2), pp.17-23.