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Study of noise pollution in engineering education: an analysis on the state of noise level in some selected suburbs of NSW

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Abstract

Noise pollution is mostly a man made phenomenon, which induces health problems when exposed to it for long term. The purpose of this engineering study is to analyse and assess the noise level of some selected suburban areas of New South Wales (NSW) in Australia. The research recognizes common sources of noise pollution, including transportation, industrial and household activities, outdoor recreation and some natural events, all of which can have detrimental effects on human health, including hearing loss, sleep disturbances, cardiovascular diseases and cognitive impairments. The research highlights substantial noise level fluctuations in various suburbs, notably in Rockdale, Kogarah, Sydenham, and Tempe, where afternoon noise surpasses the 80 dB EPA threshold in specific instances, linked to heightened vehicular traffic and human activity during school and work hours. Conversely, Hurstville suburb exhibits distinct morning noise peaks close to the EPA threshold, emphasizing the localised nature of noise pollution and the impact of specific temporal and spatial factors, while Wolli Creek maintains an average noise level close to the threshold at 76.13 dB.

Keywords: Noise pollution, decibel, human health, threshold, EPA

1. INTRODUCTION

Studies on noise pollution are an important part of engineering education, as this identifies the affected locations where appropriate sound attenuation measures can be applied. Assessing the state of noise pollution in some selected suburbs in New South Wales (NSW) of Australia can have several significant impacts on the community and policymaking. Some of these impacts include raising awareness, identifying sources and developing policies and technologies for appropriate management interventions. Raising awareness of noise pollution can be used to inform people about the adverse effects of noise pollution on their health, well-being, and quality of life. Identification of sources of noise pollution can be used to develop targeted policies and strategies to address the sources of noise pollution, such as transportation, construction, and industrial activities (Connolly et al. 2019). Appropriate policies can lead to the development of measures and regulations aimed at reducing noise pollution levels in the selected suburbs of NSW. Overall, a study on the state of noise pollution in selected suburbs of NSW can provide important information for policymakers, stakeholders, and the public to address the issue and improve the quality of life in affected areas.

Noise pollution is a type of environmental pollution caused by excessive or unpleasant sound that has adverse effects on human health and the natural environment. It occurs when the noise level in the environment exceeds what is considered safe and tolerable for human health and well-being. Traffic induced noise is one of the most common sources of pollution in urban areas. Noise generated from industrial machinery, construction sites, and manufacturing plants can also cause pollution in nearby areas. Household appliances like vacuum cleaners, washing machines, and air conditioners, and entertainment devices like televisions, radios, and loudspeakers can further contribute to noise

pollution. Moreover, activities like concerts, sporting events, and fireworks can generate high levels of noise pollution. Besides, natural events such as thunder, lightning, and volcanic eruptions can generate noise pollution. These sources of noise pollution can have adverse effects on human health and well-being, including hearing loss, sleep disturbances, cardiovascular diseases, and cognitive impairments (Babisch 2005; Hays 2017; Münzel 2017). Therefore, it is important to monitor and assess the level of noise pollution and take appropriate measures to reduce their impact on the environment. This study is significant in identifying if there is any noise pollution in suburban areas of New South Wales, especially amid Sydney's rapid population and economic growth. Focused on eight selected suburbs, the research aims to monitor and assess the level of noise pollution, which helps to inform targeted policies for noise attenuation.

2. MATERIALS AND METHODS

Eight suburbs namely Hurstville, Allawah, Kogarah, Rockdale, Wolli Creek, Tempe, Sydenham and Marrickville were randomly selected from the Sydney, NSW region for this study. The suburbs are situated in proximity to each other, and all are located within 20 km south of Sydney CBD. Data on noise levels in decibels (dB) were collected both from primary and secondary sources for verification purposes. The dB scale is logarithmic and provides a way to quantify sound intensity. On this scale, the reference point is set at zero, which represents the minimum sound pressure that can be detected by the human ear, also known as the threshold of human hearing. Different noise levels have specific associations based on their dB readings. For example, a noise level of 20 dB is comparable to a whisper, 40 dB is similar to the sound found in a quiet office environment, 60 dB marks the threshold for regular conversation, and 80 dB is the point at which noise becomes painful for humans (Maisonneuve et al. 2009a; Maisonneuve et al. 2009b). Generally, noise levels below 80 dB are considered safe, while levels exceeding 80 dB are deemed detrimental to human health according to NSW EPA guidelines (NSW EPA, n.d.).

The primary (field) data on noise in all selected suburbs were captured using Decibel X, a popular mobile phone app (Maisonneuve et al. 2009b; Maisonneuve et al. 2010) in three distinct periods, which are from 8 to 9 am, 2 to 3 pm and 8 to 9 pm. Within each of these hourly periods, data was recorded in 5-minute sections. Following each 5-minute recording, there was a 10-minute break before the next recording session began. This structured approach ensured that data recordings were obtained for each hour dedicated to data collection from highways, construction sites, residential areas, parks, and commercial areas. Noise levels in dB (D) for each source were calculated averaging different exposure levels and using Time Weighted Average (TWA) equation (Franken 1974) as below:

$$TWA = 10 \log (D/100) + 85 \quad (1)$$

$$D = 100 \sum \frac{TEi}{TPi} D = 100 \sum \frac{TEi}{TPi} \quad (2)$$

where,
TEi = Time of Noise Exposure; TPi = Time of Noise Permissible

Further, secondary data were collected from Data Noise Planet, a platform that collects and archives noise level data from various sources (Data Noise Planet, n.d.). This data is stored in *geojson* files, which allow for the recording, storage, and retrieval of noise level information for studies and analysis. Noise level data for the selected suburbs were retrieved from this secondary source to verify the validity of the data collected from the field.

3. RESULTS AND DISCUSSION

Figure 1 and 2 summarises the noise levels gathered from the primary (field) and secondary sources, which shows consistency of data between the two sources. In all selected suburbs, the average noise levels were observed below 80 dB, which is the maximum threshold level as set by the EPA. However, there were instances where noise levels exceeded maximum threshold level or remained close to such level, which posed risk to local environment.

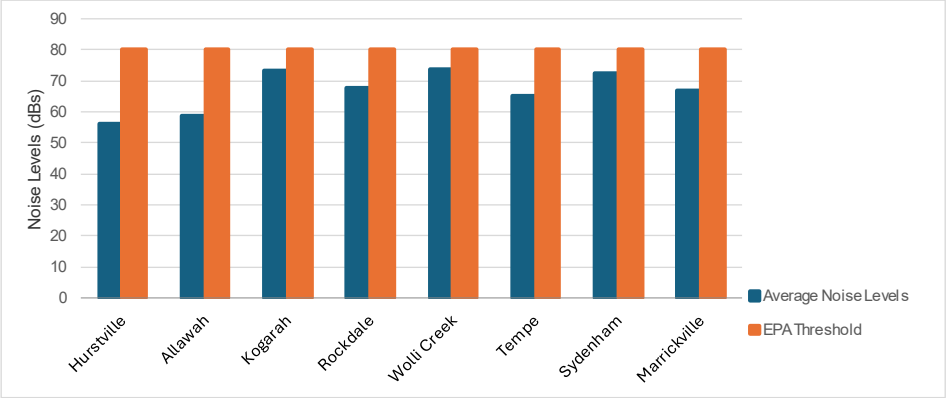

Figure 1. Average noise levels in selected suburbs of NSW compared to EPA threshold (based on field data collection in October-November 2023)

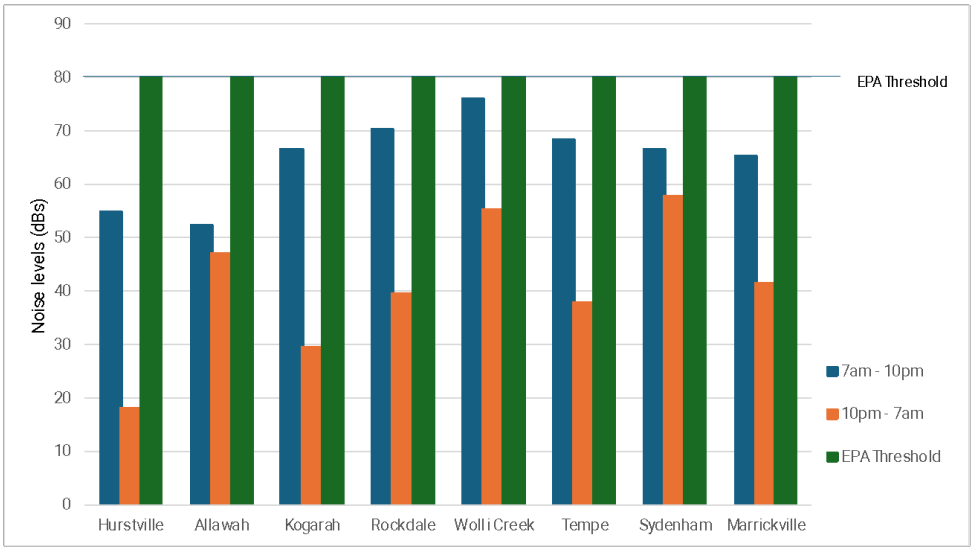

Figure 2. Average noise levels in selected suburbs of NSW compared to EPA threshold (based on secondary data source- Data Noise Planet (https://data.noise-planet.org/)

The research findings indicated notable fluctuations in noise levels across various suburbs during different times of the day. In the afternoons, particularly in the suburbs of Rockdale, Kogarah, Sydenham, Tempe, and Wolli Creek, noise levels in specific instances surpassed the EPA threshold of 80 dB. The afternoon peaks in noise levels could be attributed to various factors such as increased vehicular traffic, industrial activities, or heightened human interactions during those hours. Such observations suggest a concerning pattern of elevated noise pollution during the afternoon in these specific locations.

Contrastingly, the suburb of Hurstville exhibits a distinctive noise level pattern, with peaks recorded at 69.47 dB during the morning period of 8 to 9 am. Notably, this morning peak falls below the EPA

threshold of 80 dB. The lower noise levels during this morning timeframe in Hurstville could be influenced by factors such as reduced traffic, quieter industrial activities, or a generally calmer environment during these early hours. This discrepancy in noise level patterns between Hurstville and the other suburbs highlights the localised nature of noise pollution and the importance of considering specific temporal and spatial factors in its assessment.

Noise levels in Rockdale suburb exhibit slight variations throughout the day whereas other locations exhibit a wider range of variation. During the afternoon period in Rockdale, the noise levels exceed the EPA threshold, surpassing 80 dB by a small margin of 1 to 2 dB. Although this slight deviation may not pose an immediate threat to human health, prolonged exposure to noise levels above 80 dB can be harmful, typically if sustained for more than 8 hours. However, in this case, the elevated noise levels are limited to the afternoon period and do not persist throughout the entire day. On the other hand, during the morning and evening periods, the noise levels are high but do not exceed the established threshold. Therefore, the noise pollution experienced in Rockdale during these times has not been considered detrimental to human health. However, it is important to further monitor and manage the noise levels during the afternoon period in Rockdale to ensure a safe and healthy environment for residents.

Moreover, the research underscores important variations in noise levels within Marrickville and Allawah, shedding light on their distinct noise pollution dynamics. In Marrickville, there has been a consistent proximity to the EPA threshold, reaching a peak of 76.72 dB during the evening and 76.14 dB in the afternoon. These findings suggest sustained elevated noise levels, hinting at potential sources contributing to this phenomenon, such as increased traffic or commercial activities during these periods. On the other hand, Allawah mirrors the morning peak observed in Hurstville, with noise levels reaching 69.99 dB during this timeframe. This similarity suggests shared characteristics in the noise dynamics of Allawah and Hurstville, with a commonality in factors contributing to the morning noise peak, potentially related to reduced traffic or quieter industrial activities during those hours.

4. CONCLUSIONS

Findings on noise pollution are highly relevant to engineering education, stressing the need for future engineers to design systems that alleviate environmental noise, protect public health, and comply with regulations. Engineering curricula should incorporate acoustic design, noise control technologies, and sustainability principles, while also adopting interdisciplinary collaboration with urban planners and public health experts. Understanding the health impacts and legal contexts related to noise pollution prepares engineers to develop innovative, quieter systems for buildings, transportation, and machinery that enhance the quality of life in modern environments.

The identification of noise level variations in this study contributes valuable insights into the dynamics of noise pollution in the selected suburban areas. It suggests the need for targeted investigations into the sources of elevated noise levels in the afternoons, especially in Rockdale, Kogarah, Sydenham, Tempe, and Wolli Creek, as well as the factors contributing to the comparatively lower noise levels in Hurstville during the morning hours. Understanding these variations can aid in the development of specific interventions and policies to address the unique challenges posed by noise pollution in each suburb, ultimately working towards creating quieter and more livable environments for the residents.

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6. REFERENCES

Connolly, D., Dockrell, J., Shield, B., Conetta, R., Mydlarz, C. and Cox, T.J. (2019). The effects of classroom noise on the reading comprehension of adolescents. *The Journal of the Acoustical Society of America*, 145(1), 372-381
Babisch, W. (2005). Noise and health, *Environ Health Perspect*, 113: A14-15, doi: 10.1289/ehp.113-a14

Data Noise Planet, (n.d.). Noise-Planet - Data. [online], Available at: <https://data.noise-planet.org/> viewed on 09/12/2023.

NSW EPA (n.d.). Noise [online], New South Wales Environment Protection Authority. Available at: https://www.epa.nsw.gov.au/your-environment/noise viewed on 05/12/2023.

Franken, A. P. (1974). Community Noise Pollution, Industrial Pollution. Van Noistrand, Reinhold Company, New York.

Franken A. P., Community Noise Pollution, Industrial Pollution, Van Noistrand, Reinhold Company, New York, 1974 ed.

Hays, J., McCawley, M., Shonkoff, S.B.C. (2017). Public health implications of environmental noise associated with unconventional oil and gas development. *Science of the Total Environment*, 580 (448-456), doi.org/10.1016/j.scitotenv.2016.11.118

Maisonneuve, N., Stevens, M., & Ochab, B. (2010). Participatory noise pollution monitoring using mobile phones. *Information polity*, *15*(1-2), 51-71.

Maisonneuve, N., Stevens, M., Niessen, M. E., Hanappe, P., & Steels, L. (2009a). Citizen noise pollution monitoring. *The proceedings of the 10th International Digital Government Research Conference*, https://digital.csic.es/handle/10261/127898 viewed on 25/08/2024.

Maisonneuve, N., Stevens, M., Niessen, M. E., & Steels, L. (2009b). Noise Tube: Measuring and mapping noise pollution with mobile phones. In *Information Technologies in Environmental Engineering: Proceedings of the 4th International ICSC Symposium Thessaloniki, Greece, May 28-29, 2009* (pp. 215-228). Springer Berlin Heidelberg.

Münzel, T., Daiber, A., Steven, S., Tran, L.P., Ullmann, E., Kossmann, S., Schmidt, F.P., Oelze, M., Xia, N., Li, H., Pinto, A., Wild, P., Pies, K., Schmidt, E.R., Rapp, S. and Kröller-Schön, S. (2017). Effects of noise on vascular function, oxidative stress, and inflammation: mechanistic insight from studies in mice. *European Heart Journal*, Oct 1, 38(37), 2838-2849, doi: 10.1093/eurheartj/ehx081.