The Sound Pollution and the Impact of Various Types on Public Health

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Abstract

Noise pollution that occurs in urban areas is mainly caused by the high number of transportation vehicles. Noise pollution can have a negative impact on human health. Noise pollution can affect changes in blood pressure, hypertension, peripheral vasoconstriction, and cardiovascular disease in humans. In addition, noise pollution can interfere with non-hearing health in humans. Noise certainly interferes with human hearing which can cause a decrease in hearing function. Noise in the environment of a school can affect the cognitive level of students. Research in several cities in the world shows that the presence of green open space in urban areas can control and reduce the impact of noise pollution. the presence of green open space can be an alternative solution in dealing with noise pollution. it provides opportunities for relaxation, audio-visual attractions, ventilation of noise-contaminated environments, and easy attention can reduce the impact of noise pollution. Therefore, urban planners should adopt appropriate strategies to ensure a healthy and sustainable environment for city populations.

Keywords: Noise pollution, Noise, Human health, Non-silence, Green areas

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Introduction

The development of the current era brings rapid progress in the transportation sector. Transportation progress that is not balanced with supervision can have a negative impact. One of the main negative impacts of transportation is the emergence of noise pollution as has been reviewed in various studies (Sánchez et al., 2018). The sound produced by transportation vehicles often causes annoying noise, which is known as noise pollution.

Noise pollution is among the four largest types of pollution in the world (Dzhambov & Dimitrova, 2014). Noise pollution is considered the third most harmful pollution after air and water pollution by the World Health Organization (WHO) (Basu et al., 2021). Noise pollution is one of the most significant environmental stressors in urban environments. It is known that many activities in urban environments involve transportation. The WHO has identified noise as a pollutant since 1972 and is recognized as an important issue affecting the quality of life of urban residents (Sakieh et al., 2017).

Noise pollution, which is synonymous with urban settlements and industrialization, has great potential to cause harm to humans. Noise pollution that continuously affects humans can result in changes in blood pressure, hypertension, peripheral vasoconstriction and cardiovascular diseases (Yuen, 2014). These are diseases that can cause death. In Europe, exposure to traffic-induced noise causes the loss of at least one million years of healthy life each year (Klompmaker et al., 2019).

The Factors Causing Noise Pollution

Noise pollution is one of the major environmental pollutants that negatively affects human health, especially in urban and industrial areas (Zhang, 2021). Noise pollution is mainly caused by transportation vehicles, with traffic noise as one of the main sources. The impacts of noise pollution include sleep disturbances, stress, and increased blood pressure. Excessive noise exposure, especially at night, can lead to a higher risk of hypertension and heart disease (Münzel et al., 2017).

Noise pollution is an environmental problem that has a significant impact on urban communities, in terms of their quality of life. Various health problems can arise from high noise exposure (Yang et al., 2020). The increasing number of vehicles and the development of transportation systems have further exacerbated noise levels in urban areas, especially private vehicles causing serious problems in increasing noise levels. In the long term, noise at a certain level can reduce the quality of life of residents, especially in urban areas. In addition, noise can trigger stress which has an impact on people's welfare (Fiedler & Zannin, 2015). High traffic noise can reduce the physical and mental comfort of the occupants, increase anxiety, and decrease work productivity. In the long run, this high noise exposure can lead to more serious mental health disorders, such as chronic anxiety and depression (Fiedler & Zannin, 2015). Obviously, this has a detrimental impact on human survival.

The Phenomenon of Noise Pollution

Noise pollution has now become a very important issue to get attention. High noise pollution can certainly produce noise that disrupts daily human activities. Some cities in several countries show research on noise pollution phenomena. The following are the phenomena of noise pollution.

1. New York: In Washington Square Park area, analysis showed that more than 50% of noise complaints were related to after-hours construction activities. Data from sensors showed that many noise events exceeded the threshold set by the city's noise code (Bello et al., 2019).
2. Dublin, Ireland: The research conducted looked at how noise levels changed before and during the lockdown of activities with home alone due to COVID-19. Data was collected from 12 monitoring stations spread across various locations, with a focus on traffic-induced noise. All stations showed significant reductions in average, maximum and minimum sound levels during lockdown. Scatter plot analysis showed a significant relationship between noise levels and traffic volume at some locations, especially in downtown areas with high vehicle density (Basu et al., 2021).
3. Barcelona: Traffic noise around schools has a greater impact on children. Research shows that noise caused by traffic at school is one of the symptoms of Attention Deficit Hyperactivity Disorder/ADHD in children in Barcelona. This is characterized by changes in children's attitudes such as inattention and hyperactivity (Forns et al., 2016).
4. Belém, Brazil: Particularly in urban areas, massive urbanization that disregards vegetated land may result in noise pollution. An acoustic map of Belém that documented noise levels in 18 neighborhoods across three districts was used to measure noise pollution. All regions surpassed the acceptable noise level, according to the results. Research indicates that vegetation is known to absorb noise (De Carvalho & Szlafsztein, 2019).
5. Canada: Neurological disorders are the leading cause of disability in Canada. Recent research suggests that environmental exposures, especially traffic proximity and air pollution, may be risk factors for neurological disorders. Studies in Germany and Canada found that closer residential proximity to roads was associated with poorer cognitive performance and increased incidence of some neurological disorders (Yuchi et al., 2020).
6. Lingku, Montreal: shows that noise levels measured during commuting ranged from 54.6 to 87.6 dB(A). The World Health Organization (WHO) has determined that noise levels above 55 dB(A) in open spaces, both day and night, can cause serious disturbance. In addition, noise levels of 70 dB(A) or more in traffic areas have the potential to cause negative health effects, including hearing loss. Based on the average distribution of road traffic noise and air pollution per minute during cycling trips, it was found that cyclists spent half of their commuting time in noise levels exceeding the WHO recommended limits (Apparicio et al., 2018).
7. Switzerland: heart attack or myocardial infarction (MI) is one of the leading causes of death. Recently, attention has been increasing to environmental factors, which are potential triggers for cardiovascular health disorders. Several studies have shown that exposure to transportation noise significantly contributes to an increased risk of death from myocardial infarction (Héritier et al., 2019).
8. China: In China, noise pollution due to rapid urbanization, industrialization, and increasing number of vehicles has become a very complex environmental problem. High noise levels in China have the potential to cause various health problems for surrounding communities (Ma et al., 2018).
9. In Curitiba, Brazil: Traffic noise is one form of environmental pollution that is not realized, although it has a significant impact on public health, but many people let it happen. The main source of this noise is the sound of motor vehicles. Currently, the number of vehicles is increasing in big cities, including Curitiba. The increasing number of private vehicles and the expansion of the transportation system are worsening the noise level in urban areas, which has an impact on the quality of life of residents (Fiedler & Zannin, 2015).
10. Mexico - America: Increases in air pollution and noise from traffic are becoming a growing concern as populations move globally, especially with the increase in the elderly population. Recent studies have shown an association between exposure to air and noise pollution and metabolic disturbances that may precede various aging-related chronic diseases (Yu et al., 2020).
11. Switzerland: About 6.6 out of 7.8 million Swiss people (84%) are exposed to road noise that exceeds the 48 dB(A) threshold (Lden). Most of these people (61%) live in areas with noise levels between 48 and 60 dB(A). In 2010, transportation noise in Switzerland caused 13,800, 4600 and 4100 days of hospital stays for coronary heart disease, stroke and hypertension, respectively. Hypertension caused 77,700 general practitioner visits (Vienneau et al., 2015).
12. Faisalabad, Pakistan: In developing countries like Pakistan, noise pollution is a serious challenge due to rapid urbanization and industrialization. Faisalabad, the second largest industrial city in the Punjab region, is known as the “Manchester of Pakistan” due to its significant contribution to the textile sector. The city faces increasing noise from vehicles and intense industrial activity. Having a population of around 2.5 million, the city of Faisalabad often experiences traffic congestion and noise at various strategic locations such as industrial areas, medical centers, and educational institutions (Farooqi et al., 2019).
13. Nantes, France: In Nantes, France, noise occurs in certain areas. Higher noise is found in the city center area and around bus stops. The results show that noise has a significant impact on property prices, where every 1 dB increase decreases property value by 0.035% (Le Boennec & Salladarré, 2017). High levels of noise are known to affect comfort and this has an impact on property values in the area.

Based on phenomena occurring in several cities around the world, it can be seen that after-hours construction activities, increased number of vehicles, high traffic volume, noise around schools, massive urbanization, proximity of residences to urban traffic with above-average noise values are causing serious impacts on society. Both auditory and non-auditory impacts are in fact a serious problem that must be controlled.

The Impact of Noise Pollution

Long-term exposure to traffic noise has long been associated with cardiovascular disease, particularly hypertension. Noise-induced stress can affect hormonal and cardiovascular responses, especially at night (Foraster et al., 2014). WHO in 2012 identified several health problems related to noise pollution, such as cardiovascular disease, cognitive impairment, sleep disturbance, tinnitus, and annoyance. Various noise

sources, such as road traffic, are considered to be the main culprits affecting human health (Ariza-Villaverde et al., 2014).

The non-auditory impacts of traffic noise can cause discomfort that can trigger emotions such as irritability, fear, stress, and depression. In addition, noise also has an impact on health, for example in causing sleep disturbances and irregular rest times. These sleep disturbances can cause long-term health problems. Scientists show that there is currently increasing epidemiological evidence that long-term noise exposure contributes to cardiovascular disease, obesity, and diabetes (Gozalo & Morillas, 2016). Due to its capacity to interfere with sleep, noise has also been connected to the onset of diabetes (Fecht et al., 2016). According to a different study, the risk of diabetes in the neighborhood is positively correlated with exposure to transportation noise in residential settings. According to mounting data, noise pollution may directly affect metabolic health and should be considered when developing new public health initiatives (Shown in Figure 1) (Clark et al., 2017).

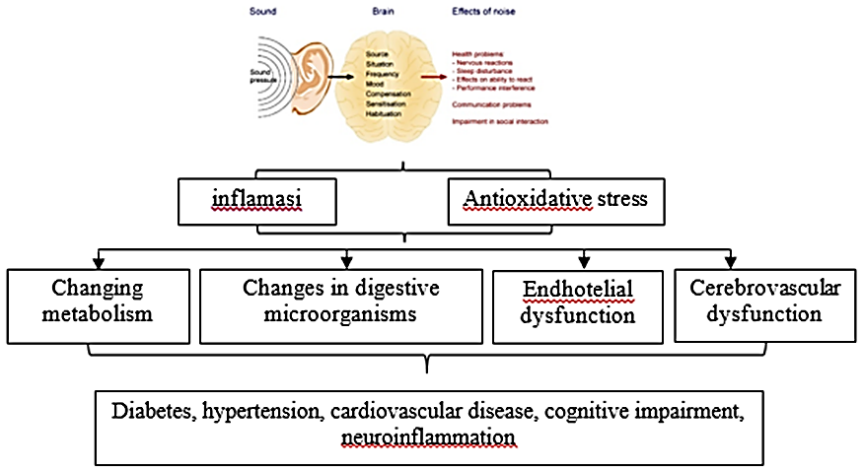

Fig. 1: Noise pollution scheme affects health

The processes via which road traffic noise effects a range of health issues and causes oxidative stress, inflammation, and chronic systemic stress hormone increases have been uncovered by recent study (Shown in Figure 2). Due to the generation of reactive oxygen species (ROS), prolonged exposure to noise pollution can cause oxidative stress and systemic inflammation, both of which are major contributors to a number of human health issues. Noise can also lead to alterations in the microbiome, neuroinflammation, vascular dysfunction, disturbance of the circadian rhythm, diseases of the central nervous system, and early aging. The intricate relationships among these variables hasten the development of health hazards that may be harmful to people's health and welfare (Hahad et al., 2022; Arregi et al., 2024).

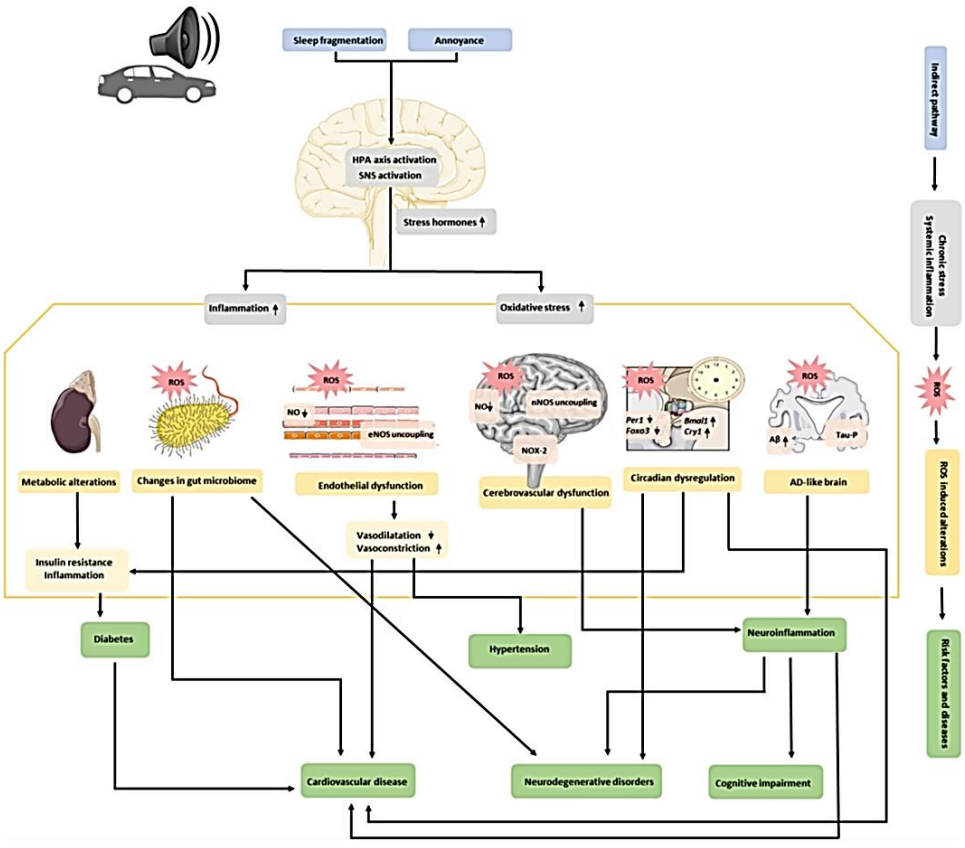

Fig. 2: The mechanism by which road traffic noise induces chronic stress hormones, systemic inflammation, and oxidative stress impacts several health outcomes. (Arregi et al., 2024)

In addition to non-hearing impacts, noise can have an impact on hearing resulting in hearing loss such as hearing loss, tinnitus, earache and other losses. Hearing loss is defined as an increase in the hearing threshold where the affected person is unable to hear words in daily life. The human ear's response to sound depends on sound frequency (Hertz) and sound pressure (decibels). The hearing range of a healthy person, in general, is 20-20,000 Hz (Jamir et al., 2014). Noise-induced hearing loss mainly occurs in the frequency range of 3,000-6,000 Hz and can be exacerbated by exposure to higher sounds. Significant hearing loss usually occurs after continuous exposure to sound at levels of 70-85 dB (Jamir et al., 2014). Hearing loss will certainly have an impact on the loss of one of the five senses in humans. This condition can interfere with the continuity of human life.

In addition to impacting the human sensory organs, noise can impact children's cognitive abilities. Studies show that noise exposure in schools, especially those close to airports or highways, can affect children's cognitive abilities, such as reading comprehension and memory (Gupta et al., 2018). A study found that children exposed to noise at school had lower reading scores, when compared to children in quieter environments (mean difference 0.80 points) (Thompson et al., 2022). Research in several European countries noted that children around noisy areas had higher levels of cognitive impairment than children in quiet neighborhoods (Gupta et al., 2018). Cognitive impairment experienced by children will certainly be able to affect the learning activities carried out. The following is data on the relationship between noise and cognitive abilities of students in Table 1 (Thompson et al., 2022).

Table 1: Relationship between Noise and Cognitive Result (Thompson et al., 2022)

	Children	Adults	Associated in literature:
Academic ability	✓	✓	✓
Attention	✓	✓	Not associated in literature:
Memory and learning	✓	×	×
Executive function	×	✓	High quality evidence
Reading and Lenguage	✓	✓	Moderate quality evidence
Fluid intelligence and general cognition	✓	50/50	Low quality evidence
Cognitive impairment	n/a	✓	Very low quality evidance
Perceptual speed	n/a	✓	

The analysis supports a general relationship between environmental noise pollution and cognition, in both children and adults. Other research shows that children in noisy environments have poorer academic performance leading to stress and poor behavior, decreased learning ability, poor reading comprehension, and lack of concentration (Hammer et al., 2014). Thus, the decline in children's learning ability caused by noise pollution greatly affects their learning outcomes.

Mitigation of Noise Pollution

Noise pollution and urban environmental problems are important factors in the context of sustainable development. The fact that these concerns were included in the 17 Sustainable Development Goals (SDGs) that were approved in 2015 is evidence of this. Economic, environmental, and social variables are the primary determinants of the implementation of the multifaceted notion of a sustainable city (Chiarini et al., 2020). Natural beauty elements including greenery, exposure to air pollution, and traffic noise are examples of influential environmental factors (Dzhambov et al., 2019). According to Dzhambov et al. (2019), green open areas surrounding homes have several advantages, such as lowering stress and noise levels, lowering exposure to air pollution, and promoting social contact and physical activity. Furthermore, green, open areas contribute to boosting physical activity and bolstering the body's adaptive immune system. According to earlier studies, green open spaces have been demonstrated to offer significant health advantages, including lowering the risk of cardiovascular disease and enhancing people's quality of life (Vivanco-Hidalgo et al., 2019). Additionally, studies demonstrate that the presence of leaves can successfully lower noise levels.

According to earlier research, urban green open spaces have a major positive impact on the environment and the communities around them, and this should be the main factor taken into account when building an urban area (Klingberg et al., 2017). More opportunities to engage with sound waves, pollution, and noise are created by the presence of green, open spaces (Sakieh et al., 2017). According to Cohen et al. (2014), urban greening has been acknowledged as a successful tactic for enhancing the microclimate, cleaning the air, and lowering noise pollution. Furthermore, having access to green, open areas is crucial for wellbeing and changes everyday habits to be more constructive. In urban settings, vegetation protects against both the beneficial and detrimental effects of pollution (Voss et al., 2021). In addition to increasing landscape usage, vegetation can lessen pollution-related long-term disruptions. The impact of noise pollution is eventually lessened by having easy access to parks, green spaces, and other open areas, which offer advantages including relaxation, air ventilation from noise pollution, audio-visual attractiveness, and improved attention (Sakieh et al., 2017). In order to give the community a more comfortable and healthy urban environment, city planners must use sensible and appropriate measures.

One crucial element in lowering noise is managing urban building density in urban planning, in addition to expanding green open areas (Yuan et al., 2019). The degree of noise pollution in the region was assessed by acoustic mapping and noise measurements in a number of traffic centers in Latin American urban cities. According to simulation studies, noise levels may be lowered by about 3 dB(A) by reducing either the overall traffic flow or the heavy vehicle traffic by 50% (Fiedler & Zannin, 2015). These results demonstrate that controlling traffic flow is a focused and successful tactic for lessening the effects of noise pollution in urban settings.

Conclusion

The sound pollution that is synonymous with urban settlements and industrialization has great potential to cause harm to humans. Noise pollution is generally caused by transportation vehicles. The increase in the number of vehicles, especially private vehicles, as well as the

development of existing transportation systems, can trigger high noise levels in urban areas. High noise can affect the physical and mental comfort of people who are close to the location of the noise. Long-term exposure to noise can cause hearing and non-hearing health problems.

The general hearing health disorder that affects humans is the decline in hearing quality. Meanwhile, non-hearing disorders can cause several chronic diseases, such as cardiovascular diseases. In children's development, noise that occurs near schools can cause weak cognitive abilities in children. Children whose schools are located close to the highway will have difficulty understanding lessons. Research in several cities in several countries shows that the availability of green areas or green open spaces in urban areas can be a solution to control noise pollution. The presence of foliage in green areas can reduce noise levels. The importance of urban planning is a consideration that must be taken into account to ensure a healthy and safe environment for urban residents.

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