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Impact of noise pollution during the COVID-19 pandemic in a hospital area in Sorocaba city, São Paulo State, Brazil

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ABSTRACT

Environmental noise is a public health problem that arises mainly from vehicular traffic. In noise-sensitive areas, such as hospitals, the harm is even greater, as noise affects the recovery of patients and causes stress and disturbance to employees. Noise control measures are usually restricted to simulations and mathematical modeling. Given this context, the present study assesses environmental noise around a public hospital in Sorocaba city, São Paulo State, Brazil, before and during the COVID-19 pandemic, benefiting from measures to restrict the circulation of vehicles and people. Measurements were performed in triplicate, on weekdays, at four points around the hospital during the day, and followed the guidelines of standard NBR 10.151/2019. The number of light and heavy vehicles was counted manually. The equipment used was the BK 2260 analyzer and a tripod with adjustable height. The circulation of light and heavy vehicles decreased significantly during the pandemic. However, this decrease was not enough for sound levels to meet the 50 dB(A) recommended for noise-sensitive areas. This fact can be due to the speed of the remaining vehicles being above the established for the surrounding streets. Vehicles are the main responsible for the high levels of noise in the area, overlapping the levels generated by the different activities in the study site.

KEYWORDS: Environmental noise. Sars-CoV-2. Hospitals.

1 INTRODUCTION

Hospitals are places for the treatment, rest, and recovery of patients (LOUPA, 2020). These buildings are usually located in city centers for reasons of logistics and population access. However, this strategic location is intensely affected by noise pollution stemming mainly from vehicular traffic (MONTES-GONZÁLEZ et al., 2019).

Hospital areas are noise sensitive and have more restrictive values in terms of sound pressure levels expressed in standards and recommendations of international organizations. The Brazilian Association of Technical Standards (ABNT), through NBR 10151/2019, establishes sound pressure level limits of up to 50 dB(A) during the day and up to 45 dB(A) at night in hospital areas (ABNT, 2019). The World Health Organization (WHO) suggests that sound pressure levels do not exceed 35 dB(A) during the day and 30 dB(A) at night in hospital environments (BERGLUND et al., 1999). The United States Environmental Protection Agency (USEPA) recommends daytime and nighttime sound levels of less than 45 and 35 dB(A), respectively (USEPA, 1974).

The impacts of noise pollution in hospitals interfere with the health of patients and employees and with hospital dynamics. Patients are affected by sleep disorders (BASNER; McGUIRE, 2018), annoyance, and delayed recovery (ZANNIN et al., 2019). Furthermore, this condition increases the incidence of rehospitalization (HAGERMAN et al., 2005). In health professionals, stress and an increased chance of medical errors are some of the problems arising from noise pollution (BUSCH-VISHNIAC; RYHERD, 2019; ZANNIN et al., 2019).

Several studies around the world have evaluated vehicle noise in hospital areas (ZANNIN; FERRAZ, 2014; RAVINDRA et al., 2016; MONTES-GONZÁLEZ et al. 2019; ANDRADE et al., 2021a). Mitigating measures for this type of pollution usually correspond to simulations in acoustic software, with implementation of a reduction in the fleet of circulating vehicles (total, heavy), replacement of the type of asphalt, and reduction in vehicle speed (FIEDLER; ZANNIN, 2015; MONTES-GONZÁLEZ et al., 2019). It is difficult to implement effective measures to assess the reduction in noise pollution due to the complexity of factors involved in city dynamics.

In this sense, one of the implications of the COVID-19 pandemic was the reduction in the circulation of vehicles and people in urban centers so as to contain the spread of the virus and protect people. This change in urban dynamics brought a great opportunity for concrete noise reduction assessments (ASENSIO et al., 2020a; RUME; ISLAM, 2020; RUMPLER et al., 2020; STEELE; GUASTAVINO, 2021).

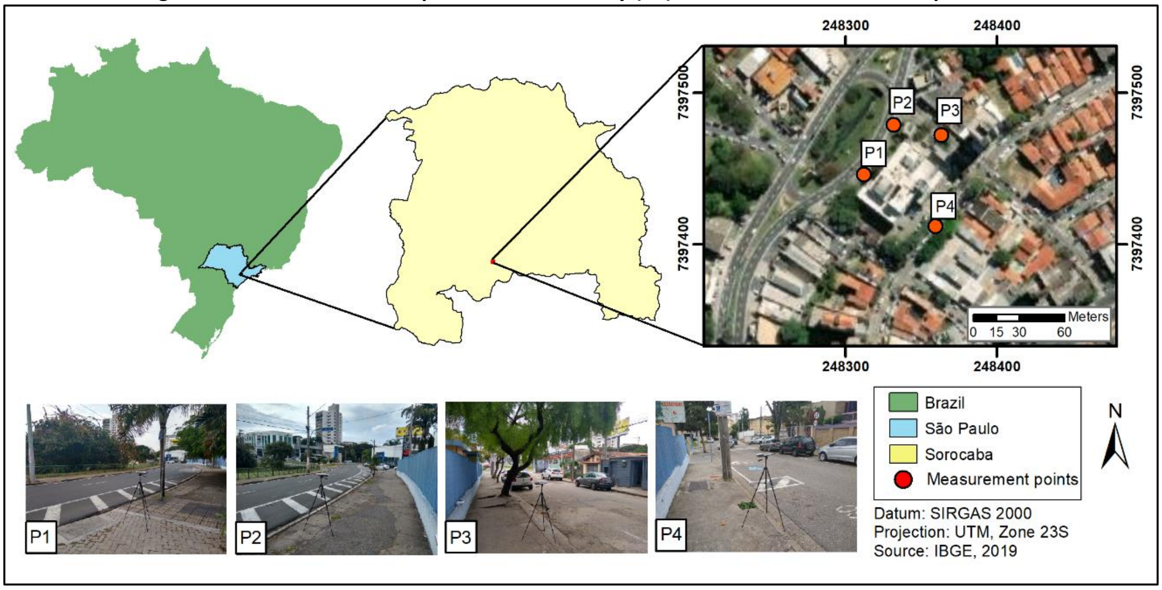
Given the above, this study assesses the impact of noise from vehicles circulating around a hospital in Sorocaba city, in the interior of São Paulo State, Brazil, before and during the quarantine measures imposed due to the COVID-19 pandemic.

2 METHODS

2.1 STUDY SITE

The public hospital under study is a reference in pediatric oncology, serving children from zero to eighteen years old in Sorocaba and 47 other cities in the region. It is located in the central region of Sorocaba city (SP), with shops, residences, and commercial buildings in its surroundings, in addition to an avenue with a large flow of vehicles. Figure 1 shows the location of the hospital and the sites evaluated.

Figure 1: Location of the hospital in Sorocaba city (SP) and sound measurement points



Source: Elaborated by the authors (2021).

2.2 SOUND MEASUREMENTS

Four sound measurement points were selected around hospital, called P1, P2, P3, and P4. Points P1 and P2 are located on the avenue with greater circulation and speed of vehicles in the surroundings. Each point had a 10-minute sound measurement period (FIEDLER; ZANNIN, 2015; ANDRADE et al., 2021b), in triplicate, during the daytime on different weekdays (Monday to Friday), before (May and June 2019) and during the COVID-19 pandemic (April 2020).

The sound analyzer used was the BK 2260 (class 1), installed on a height-adjustable tripod. The analyzer was adjusted for fast response time, 'A' weighting circuit, and dynamic range between 30 and 110 dB(A). Sound measurements followed the guidelines of standard NBR 10151/2019 (ABNT, 2019).

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The parameters evaluated were: equivalent sound pressure level (L_{eq}); maximum level (L_{max}); minimum level (L_{min}); and the statistical levels L_{10}, corresponding to the sound level exceeded during 10% of the measurement time (having a good association with traffic noise); L_{50}, which is the sound level exceeded during 50% of the measurement time, representing an average of the fluctuating noise levels; and, finally, L_{90}, which is the level exceeded during 90% of the measurement time, which correlates with background or residual noise.

At points P2 (near P1), P3 and P4, a manual counting of light (cars and motorcycles) and heavy vehicles (buses and trucks) was performed for one hour, before and during the pandemic, to assess whether there was a reduction in vehicle circulation.

3 RESULTS AND DISCUSSION

3.1 CHANGE IN VEHICLE CIRCULATION DURING THE PANDEMIC

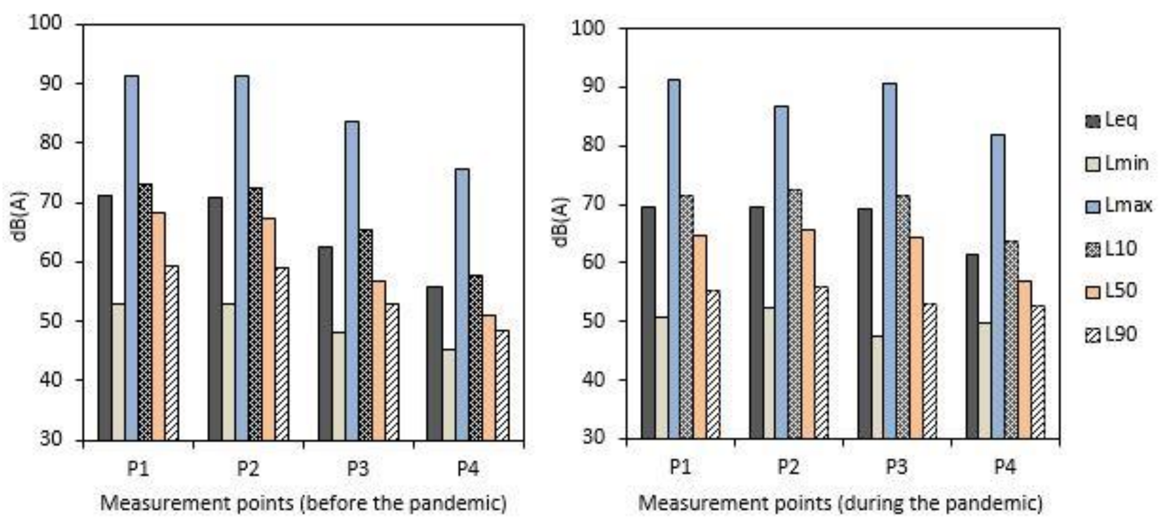
The counting of vehicles showed that the rate of light vehicles circulating decreased by 34.8% at P2, 58.6% at P3, and 68.7% at P4 during the pandemic. For heavy vehicles, there was a reduction only at P2, of about 75%. For the other points, both before and during the pandemic, the circulation of vehicles for one hour was the same (one vehicle on average).

Other parts of the world showed similar or even higher rates of reduction. In Sydney, Australia, vehicular traffic decreased by 52 and 81% on arterial roads and central shopping streets, respectively (STEELE; GUASTAVINO, 2021). French government data showed reductions in the vehicle fleet in the order of 60-75% (MUNOZ et al., 2020).

3.2 SOUND AND STATISTICAL LEVELS BEFORE AND DURING THE PANDEMIC

Figure 2 shows the equivalent (L_{eq}), maximum (L_{max}), minimum (L_{min}), and statistical sound levels (L_{10}, L_{50}, and L_{90}) before and during the pandemic.

Figure 2: Sound and statistical levels before and during the COVID-19 pandemic



Source: Elaborated by the authors (2021).

Even with a significant reduction in the number of circulating vehicles due to the quarantine measures imposed by the pandemic, Figure 2 shows that L_{eq} decreased only by 1.5 dB(A) at P1, and by 1.1 dB(A) at P2, points located on the avenue with the greatest circulation and speed of vehicles (set for the location at up to 50 km/h). On the other hand, L_{eq} increased at points P3 and P4 during the pandemic (by 6.7 and 5.5 dB(A), respectively). Likewise, for the other sound levels, L_{min} increased during the pandemic only at P4 (from 45.3 to 49.9 dB(A)), and L_{max} increased at P3 and P4 (from 83.6 to 90.6, and from 75.5 to 81.9 dB(A), respectively).

This low reduction in equivalent, minimum, and maximum noise at the points located on the avenue with the greatest circulation and speed of vehicles (P1 and P2) may correlate with the speed of the remaining vehicles which, during *in situ* measurements, were found to be above the 50 km/h established for the track. For the other points, the speed of the vehicles and the bad condition of the asphalt may have been the factors that influenced the increase in noise levels. Other studies also indicate the possible influence of the speed of the remaining vehicles during the pandemic as the cause of lower than expected reductions in noise levels (ASENSIO et al., 2020b; ANDRADE et al., 2021b).

Another aspect that contributes to greater speed of the remaining vehicles refers to the fact that the streets are freer for traffic flow (STEELE; GUASTAVINO, 2021), corroborating, in this case, with higher sound levels (ALETTA et al., 2020b).

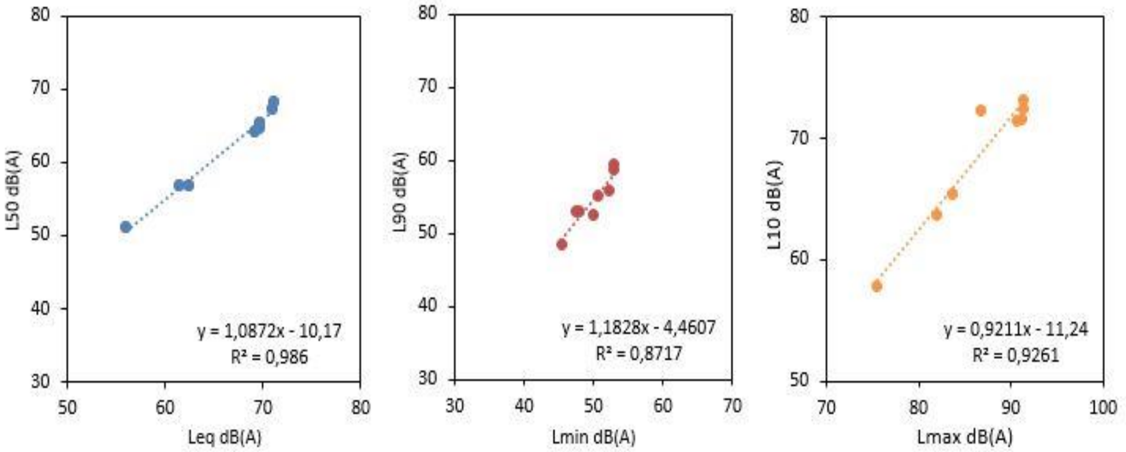
For statistical levels, reductions in values (P1 and P2) and increases during the pandemic (P3 and P4) followed the same criteria as for sound levels. Noise events (L_{10}), even during the pandemic, ranged from 63.7 to 72.3 dB(A) at points P4 and P2, respectively. The variation of L_{50} (56.8 to 65.5 dB(A)) and L_{90} (52.6 to 55.9 dB(A)) occurred at the same points, that is, the point of least circulation and one of the points of higher vehicle traffic. Background noise and vehicle noise events ranged from 11.1 to 16.4 dB(A) ($L_{10} – L_{90}$ for P4 and P2), with greater fluctuation of sound levels for the road with greater vehicle circulation.

In the study by Aletta et al. (2020a), the authors found that the statistical descriptors L_{10} and L_{90} followed the reductions in equivalent sound levels (L_{eq}), suggesting a reduction in noise and background noise events during the pandemic.

3.3 CORRELATION BETWEEN ACOUSTIC DESCRIPTORS

Figure 3 shows a linear correlation between sound and statistical levels. The results show a strong correlation between the average levels L_{eq} and L_{50} (R^2 = 0.986); between minimum level and background noise, L_{min} and L_{90} (R^2 = 0.871); and between maximum level and noise events, L_{max} and L_{10} (R^2 = 0.926). Therefore, vehicles are primarily responsible for maintaining average noise levels well above the recommended by NBR 10151 for the daytime in noise-sensitive areas, which is up to 50 dB(A). Moreover, there is a large amplitude between high and low levels, even overlapping the sound levels generated by the hospital surroundings.

Figure 3: Correlation between sound and statistical levels



Source: Elaborated by the authors (2021).

4 CONCLUSION

The present study showed that in the quarantine period established by the governor of São Paulo State during the COVID-19 pandemic, vehicle circulation decreased significantly around a noise-sensitive area, a hospital located in Sorocaba city (SP).

Even with this significant reduction, noise levels generated by the remaining vehicles are well above the recommended by the national standard (which assesses noise in communities) for the study area. Statistical levels showed that vehicles are the main responsible for high noise levels during the pandemic, with a strong correlation between average, minimum, and maximum values.

The results shown here can serve as a basis for municipal managers to verify whether the region in question needs effective measures to reduce vehicle noise and the possible impacts on patients, employees, and medical staff. Possible solutions to be adopted are: speed control systems for the surrounding roads, maintenance or replacement of the type of asphalt (using porous asphalt, which is a more acoustically absorbent material than common asphalt), driver education campaigns, among others.

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