



## Editorial

## Traffic Noise and Respiratory Diseases: Is There Evidence?☆

### Ruido de tráfico y enfermedades respiratorias: ¿hay evidencias?

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The World Health Organization (WHO) recently published their “Environmental Noise Guidelines for the European Region”,<sup>1</sup> examining the impact of traffic noise on non-auditory disorders, including cardiovascular diseases, specifically ischemic heart disease and hypertension. However, no mention is made of the possible impact of traffic noise on respiratory diseases, despite scientific evidence that these factors are correlated.

One of the first scientific articles to mention the association between environmental noise and respiratory diseases is a study conducted in the city of Madrid.<sup>2</sup> In this article, respiratory-related emergency admissions to the Hospital General Universitario Gregorio Marañón among the general population were correlated with daytime noise levels in Madrid. This article, which used 2 different statistical analysis methodologies, concluded that for every 1 dB(A) increase in the level of environmental noise, respiratory-related hospital admissions and mortality (ICD-10: J00–J99) rise by about 3%. Subsequent studies have associated traffic noise with bronchitis and asthma,<sup>3,4</sup> with pneumonia (ICD-10: J12–J18) in children,<sup>5</sup> and more recently, with altered lung function in children.<sup>6</sup>

Studies have also been published that correlate noise not only with respiratory disease morbidity, but also with mortality. An ecological time-stratified analysis<sup>7</sup> that associates respiratory mortality with traffic noise in Madrid was published in 2014. This article, which focuses on the population of individuals older than 65 years, shows that for every 1 dB(A) increase in daytime noise in Madrid, daily respiratory mortality increases by 4.8%. No association was detected in individuals aged under 65 years. The results were controlled for various confounding factors such as flu epidemics, the existence of other atmospheric pollutants, and even the pollen concentrations of some species. Daytime noise is taken as noise occurring between 8 and 22 h, while night-time noise is noise measured between 22 and 8 h.

The authors conducted a second study to evaluate the impact of noise on daily respiratory mortality in Madrid and to compare it to cardiovascular mortality (ICD-10: I00–I99).<sup>8</sup> They found that for

each dB(A) of daytime noise in Madrid, 184 people over the age of 65 years die (95% CI: 0–356) due to respiratory causes. This value is slightly lower than cardiovascular mortality (284, 95% CI: 31–523). If the impact of noise is compared with annual respiratory mortality attributable to 10 µg/m<sup>3</sup> increments in the concentration of PM<sub>2.5</sub>, a total of 95 deaths are detected (95% CI: 0–190).<sup>8</sup>

Increments in noise of 1 dB(A) are compared with PM<sub>2.5</sub> increments of 10 µg/m<sup>3</sup>, as these are the standard values for noise and chemical pollution variables used in epidemiological studies of this kind.<sup>8</sup>

The specific causes that might explain this association were subsequently analyzed in a case-crossover study conducted in a population older than 65 years of age, including mortality due to all respiratory causes and to asthma (ICD-10: J45–J46), pneumonia (ICD-10: J12–J18), and COPD (ICD-10: J40–44, J47). The results show that there is no statistically significant association between noise levels at night and asthma mortality, but that night-time noise is associated with mortality due to pneumonia and COPD.<sup>9</sup> If another health indicator is selected, such as the number of calls to the emergency services, the conclusion is also that noise is associated with calls prompted by respiratory diseases, and that the impact of respiratory diseases is higher than that of cardiovascular diseases.<sup>10</sup>

Biological mechanisms that might explain these associations were recently proposed by Recio et al.<sup>11</sup> According to this study, these associations could be explained in 3 ways:

- The first involves alterations of the immune system caused by the stressor effect of noise. The association between psychological stress and the development and exacerbation of respiratory diseases has been widely studied.<sup>12</sup>
- The second concerns sleep disturbances caused by noise at night. Studies in animals and humans have found associations between sleep cycles and the neuroendocrine and immune systems.<sup>13</sup>
- The third mechanism may be oxidative stress. In addition to chemical pollution, smoking, and viruses and bacteria, another source of oxidative stress is the inflammatory processes associated with psychological stress, such as that caused by traffic noise. Oxidative stress reduces antioxidants involved in the immune system response and contributes to the progress of diseases such as pneumonia.<sup>14</sup>

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In our opinion, there is sufficient evidence to show the existence of a robust statistical association between levels of traffic noise and morbidity and mortality due to respiratory causes. Firstly, this association is maintained when different health indicators such as infant mortality, hospital admissions, and even calls to the emergency services are analyzed. Furthermore, similar associations have been found in different locations, using different methodologies, and, lastly, biological mechanisms have also been proposed that explain the plausibility of the associations found.

In view of the foregoing, traffic noise can be considered a risk factor for respiratory-related morbidity and mortality, of at least the same order of magnitude as conventional chemical pollution in a big city. However, more research along these lines using various epidemiological designs is required to clearly establish the relationship between traffic noise and respiratory diseases.

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