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# The FAA's 65 dBA DNL is not a safe noise exposure level for the American public

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The Federal Aviation Administration's (FAA) 65 A-weighted decibel (dBA) day-night average sound level (DNL) is not a safe noise exposure level for the American public. In response to the 1976 Aviation Noise Abatement Policy, using annoyance as the measure of aviation noise effects on the public, the FAA adopted 65 dBA as the threshold of significant noise exposure, below which residential land uses are compatible. The Environmental Protection Agency, however, calculated that the safe noise levels for the public are DNL  $\leq 55$  dB to prevent outdoor activity interference and annoyance and  $\leq 45$  dB to prevent indoor activity interference and annoyance. Noise has both auditory and non-auditory health effects. Commercial and general aviation noise exposure have not been shown to cause auditory disorders in the public, but do have non-auditory health effects. Noise exposure is stressful and nighttime noise disrupts sleep. The associations between aviation noise exposure and its adverse health effects are well documented, with likely mechanisms by which the effects occur proposed based on human and animal research. For population health and safety, aviation noise must be reduced.

## INTRODUCTION.

The Federal Aviation Administration (FAA) states, “While there are many benefits to air travel, aircraft noise can be a concern for communities. The FAA is limited by the simple reality that aircraft make noise.”<sup>1</sup> The term *aviation noise* will be used in this paper to denote noise made by non-military aircraft affecting people living in communities near airports and under flight paths. Noise has both auditory and non-auditory effects on human health.<sup>2</sup> Commercial and general aviation noise exposure has not yet been shown to cause auditory disorders in the public. It is sufficient, however, to cause severe adverse non-auditory health effects. The associations between aviation noise exposure and adverse health effects are well documented, with likely mechanisms by which these effects occur proposed based on human and animal research.<sup>3</sup> Given projections for future growth in the number of aircraft operations<sup>4</sup> it is essential that the safe aviation noise exposure level be known.

In defining what it called the “aircraft noise problem,” the FAA’s 1976 Aviation Noise Abatement Policy<sup>5</sup> (ANAP) characterized aircraft noise exposure of DNL 65 to 75 dBA in residential areas as “significant” and DNL 75 dBA or more as “severe,” and related these noise exposure levels to previously used interpretations of expected community actions based on case studies. The FAA states that the ANAP identified 65 dBA as the noise exposure level above which aircraft noise “create[s] a significant annoyance for most residents”, but according to the FAA did not provide any additional information supporting this characterization.<sup>6</sup> The ANAP actually did discuss noise levels in terms of the Noise Exposure Forecast (NEF), noting that NEF 30 is equivalent to DNL 65 dB. For noise levels below NEF 30, the ANAP stated, “Essentially no complaints expected; noise may interfere with community activities.” In another online document, the FAA states, “FAA has adopted DNL 65 dBA as the threshold of significant noise exposure, below which residential land uses are compatible.”<sup>7</sup> The FAA has since used the 65 dBA DNL standard as its “noise goal” for reducing the number of people exposed to significant aviation noise around American airports. Despite overwhelming evidence that too many Americans think they are exposed to excessive aviation noise, the FAA persists in claiming that it has successfully done this.<sup>8</sup>

In 1992 the Federal Interagency Committee on Noise (FICON) concluded that DNL was the appropriate noise exposure metric and annoyance the proper measure to determine noise impacts on populations, making this official U.S. federal policy.<sup>9</sup> In 2023 the FAA still considers aviation noise to be merely an annoyance. Both FICON and the FAA relied upon the Schultz Curve<sup>10</sup> to describe transportation noise-community annoyance relationships. (See Figure 1.) The many problems associated the Schultz Curve have been discussed in detail by Fidell in 2003<sup>11</sup> and by others.<sup>12,13</sup>

On its Community Response to Noise webpage, the FAA currently states,

*“To represent the effect of aircraft noise exposure on people, researchers in the 1960s and 1970s developed the concept of noise annoyance. This concept proved useful in understanding how communities felt about the noise from the*

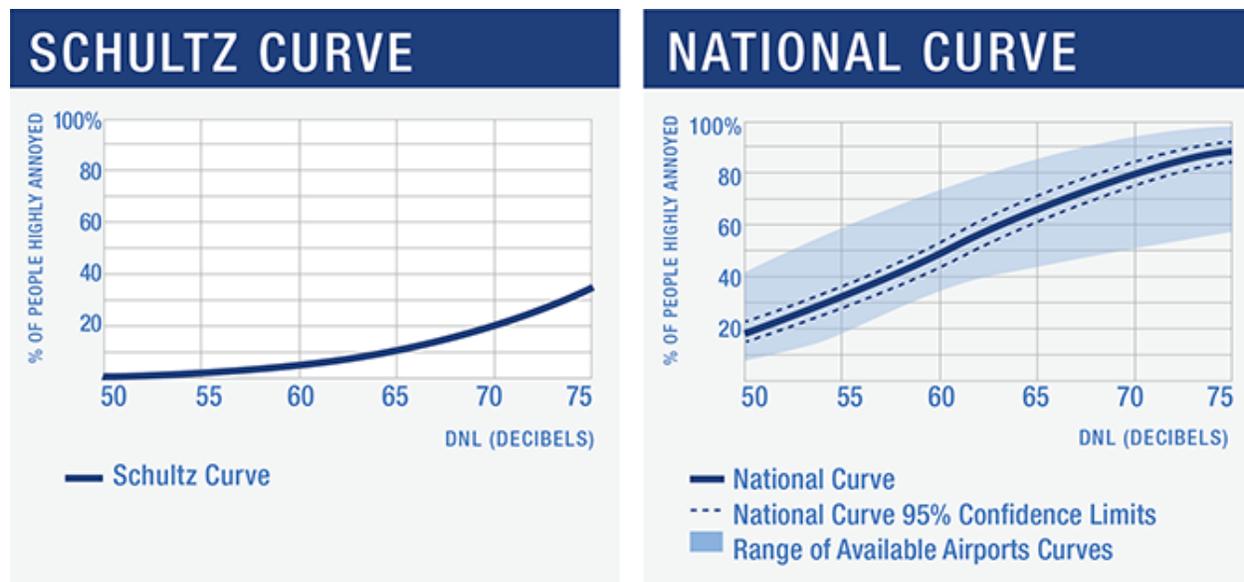
*new aircraft of the jet age. There are several factors that affect the extent of annoyance that a noise causes. How loud is the noise? How long did it last? How often did the noise occur? When did the noise occur: was it during nighttime? Did the noise occur against a backdrop of other noises or did it occur in an otherwise quiet place?”<sup>7</sup>*

Over the last four decades, thousands of published articles in the international peer-reviewed scientific and medical literature document that noise isn't just an annoyance but is a health and public health hazard, interfering with human activity and causing cardiovascular disease and increased mortality. The adverse effects of noise are acknowledged in the new definition of noise, *noise is unwanted and/or harmful sound*.<sup>14</sup> The new definition opens the American Public Health Association's 2021 Policy Statement, *Noise As a Public Health Hazard*<sup>15</sup> and was adopted for use and added to its Constitution by the International Commission on Biological Effects of Noise in 2023.<sup>16</sup> Aviation noise is among the noise sources covered by the new definition.

In 2021, the FAA reported the results of the 2015-2016 Neighborhood Environmental Survey (NES)<sup>17</sup>. The NES National Curve found that many more people were highly annoyed by aircraft noise than the Schultz Curve had indicated. (See Figure 1.) One explanation of the difference between the Schultz Curve and the NES results may be the FAA's implementation of its Next Generation Air Transportation System (NextGen) which rationalized aircraft traffic patterns through satellite based navigation, concentrating flight paths over specific neighborhoods near commercial airports.<sup>18</sup> The NextGen program led to complaints and lawsuits about aircraft noise in multiple cities from coast to coast.<sup>19</sup> The overall increase in air traffic in recent decades<sup>20</sup> may explain complaints about noise from general aviation operations. Aviation noise pollution continues to be a major problem for millions of people living in the United States.<sup>21</sup>

## **THE FAA'S 65 dBA DNL IS NOT A SAFE NOISE EXPOSURE LEVEL**

The DNL metric used by the FAA is defined as the average sound energy in a 24-hour period with a 10-dB penalty added to nighttime noise levels from 10 p.m. until 7 a.m.<sup>22</sup> The Environmental Protection Agency (EPA), however, calculated that the safe noise exposure levels for the public to prevent interference with human activity were DNL 45 dB for indoor noise and 55 dB for outdoor noise<sup>23</sup>, making the 65 dBA DNL an unsafe noise exposure level for the public. (The EPA used  $L_{dn}$  instead of DNL, but both terms have the same meaning.) The EPA's lower indoor noise level reflects the noise reduction inside a structure due to the sound-blocking effects of ceilings, walls, and windows. The EPA's outdoor safe noise level of DNL 55 dB is most directly comparable to the FAA's DNL 65 dBA since both are measured outdoors.



**Figure 1.** Schultz Curve and National Curve. Reproduced from FAA, Neighborhood Environmental Survey.<sup>17</sup>

Additionally, average noise exposure metrics such as DNL do not adequately describe the adverse impacts of aviation noise on overflight communities and those near airports. One aviation noise event/day at 114.4 dBA, 10 events/day at 104.4 dBA/event, 100 events/day at 94.4 dBA/event, and 1,000 events/day at 84.4 dBA/event all yield the same DNL of 65<sup>13</sup>, but the impacts of repetitive aviation noise events on those exposed will be markedly different. (See Figure 2.) The number of noise events above a certain decibel level, especially the number of nighttime noise events, has been proposed as a better metric for aviation noise.<sup>24,25</sup> This metric reflects the inability of the human body to habituate to aviation noise events, even if the listeners think they are used to them.<sup>26,27</sup> Every noise event causes involuntary physiological increases in heart rate, blood pressure, and stress hormone levels. There may even be a “priming” effect where the responses increase with repeated aviation noise exposures. The number of noise events is not a theoretical concern: In 2021, the 10 busiest U.S. airports each reported more than 1,000 aircraft movements/day, with the busiest (Hartsfield-Jackson Atlanta International Airport) reporting about 2,000 flights daily.<sup>28</sup>

Also, dBA may be an inappropriate measure of aviation noise. The Occupational Safety and Health Administration states, “The A-weighted sound pressure level measurement is thought to provide a rating of noise that predicts the injurious effects the noise has on human hearing and has been adopted by OSHA in its noise standards.”<sup>29</sup> The health concerns about aviation noise are about the non-auditory health effects of exposure. Aviation noise has a large low frequency component <200 Hertz and infrasound components <20 Hertz.<sup>30</sup> Low frequency sound travels greater distances than higher frequency sound and penetrates walls more readily.<sup>31</sup> Unweighted or C weighted sound measurements may be more appropriate for aviation noise.



The WHO recommendations acknowledge the adverse health effects of aircraft noise, with the  $L_{den}$  (the Day-Evening-Night Level) even more restrictive than the FAA's DNL, with an additional 5 dB penalty for evening noise from 7 p.m. until 11 p.m.

## ANNOYANCE FROM AVIATION NOISE IS A SERIOUS HEALTH ISSUE

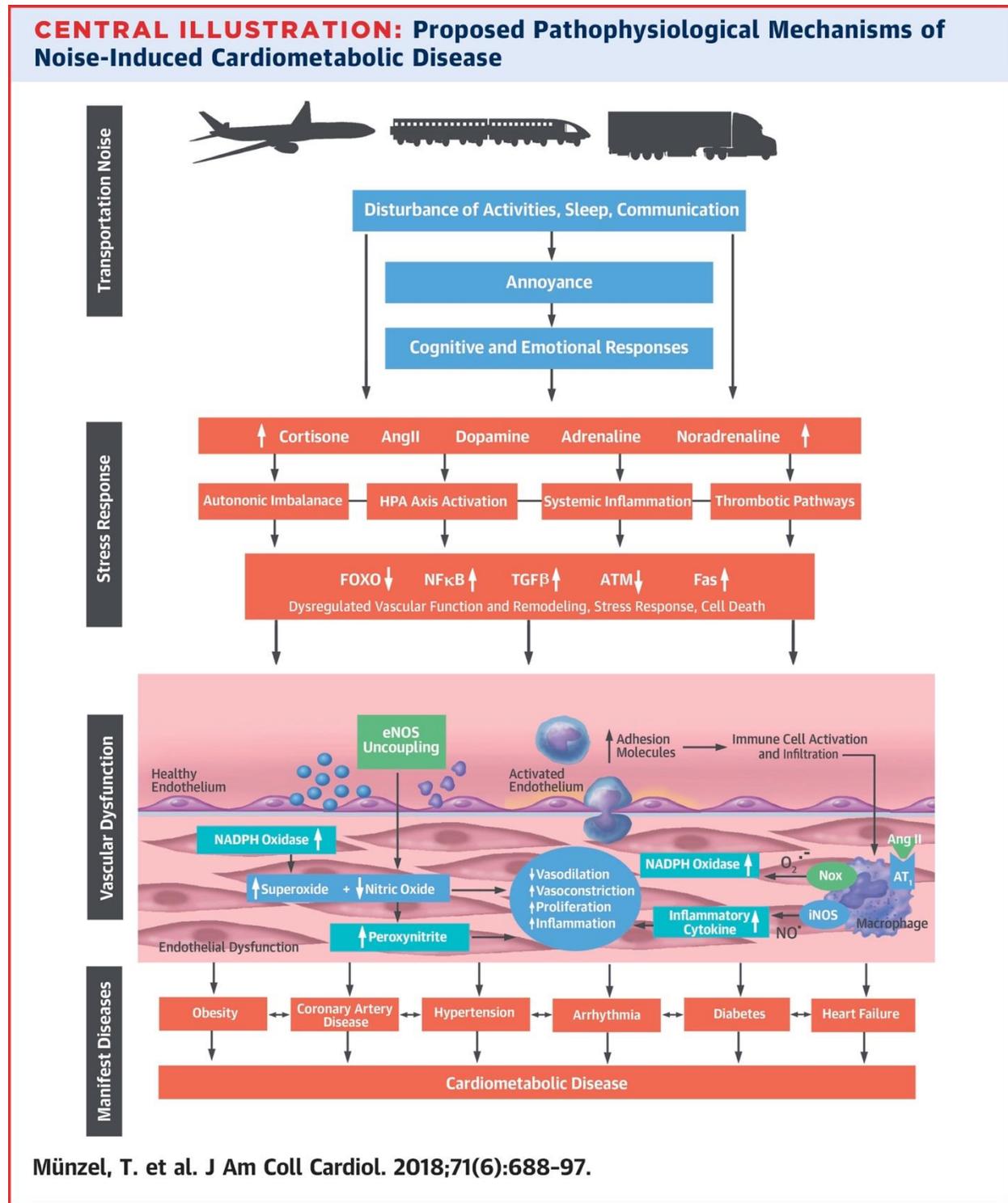
Even if we accept annoyance as the only measure of the impact of aviation noise, though, there is a direct through-line from aviation noise exposure to adverse cardiovascular effects and increased mortality. The associations between aviation noise exposure and adverse health effects are well documented, with likely mechanisms by which these effects occur proposed.<sup>3</sup> These proposed physiological mechanisms are outlined graphically in Münzel et al.'s Central Illustration.<sup>3</sup> (See Figure 3.)

Noise annoys people. Annoyance is stressful. Noise by itself causes stress.<sup>34</sup> The manifold adverse health impacts of stress on almost every body system cannot be overemphasized.<sup>35</sup> Among them, stress causes inflammation of the vascular intima (arterial lining), leading to cardiovascular disease and increased mortality.<sup>36</sup> This effect has specifically been shown to be caused by transportation noise.<sup>37</sup> Aviation noise causes cardiovascular and hormonal responses to which the human body does not habituate.<sup>26,27</sup> This cascade of physiological events includes almost instantaneous increases in heart rate and blood pressure mediated by the autonomic nervous system; slightly slower increases in stress hormone levels due to activation of the hypophyseal-pituitary-adrenal axis; and a longer term inflammatory response.

The health impacts of aviation noise are not theoretical. A study of more than 6 million American Medicare recipients showed a higher cardiovascular hospital admission rate for those living near airports<sup>38</sup> and a more recent study in Zurich, Switzerland directly linked nighttime aviation noise to heart attacks.<sup>39,40</sup> No more research is needed to know with a high degree of certainty that aviation noise adversely affects the health of those exposed to it.

The strength of the accumulated scientific evidence meets the Bradford Hill criteria for causality.<sup>41</sup> The world's experts agree. In 2014 Babisch wrote [bolding added],

*“Chronic long-term exposure to transportation noise has been shown to be associated with the prevalence and incidence of cardiovascular diseases, including hypertension, ischemic heart diseases and stroke. The evidence of the association is based on experimental work carried out in the laboratory regarding the biological plausibility (coherence), the consistency amongst study results (different study designs, different populations, different noise sources), the presence of an exposure-response relationship and the magnitude of the effect. **The question is no longer whether noise causes cardiovascular diseases; it is rather to what extent.**”<sup>42</sup>*



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**Figure 3.** Reproduced without change from Münzel, T. *et al.* J Am Coll Cardiol. 2018;71(6):688-97 under Creative Commons license CC BY-NC-ND 4.0 DEED (<http://creativecommons.org/licenses/by-nc-nd/4.0/>)

In 2016, Basner wrote,

*“The overwhelming majority of noise effect researchers today accept that there is a causal relationship between environmental noise exposure and increased cardiovascular risk.”*<sup>43</sup>

## CONCLUSION

The FAA still states that 65 dBA DNL is compatible with residential land use. The EPA, however, calculated that the daily safe noise exposure level for the public is DNL 55 dB for outdoor noise and DNL 45 dB for indoor noise. In 2018, WHO acknowledged the adverse health effects of aviation noise and recommended aviation noise exposure levels similar to safe noise levels calculated by the EPA more than 40 years earlier. The FAA is at least now willing to consider adverse health effects of aviation noise<sup>44</sup>, rather than treating aviation noise as merely an annoyance. Until now, though, one can only conclude that the FAA has deliberately refused to accept the overwhelming evidence that aviation noise is a health problem, thereby allowing Americans to be exposed to unsafe levels of aviation noise.

The FAA’s stated mission is “to provide the safest, most efficient aerospace system in the world.”<sup>45</sup> When will it extend its concerns about safety to those Americans living near airports and under flight paths? The technologies exist now to reduce aviation noise- the largest commercial airliner, the Airbus A-380, is also one of the quietest in the air- and new propulsion and airframe technologies are being developed to make aircraft even quieter.<sup>46,47</sup> Operational changes, such as limiting hours of operation or modifying performance-based navigation systems to reduce the effect of concentrated flight paths on those living beneath them, require no new technologies and can be implemented immediately.

No more research is needed to know with a high degree of certainty that aviation noise has adverse effects on human function and health, with nighttime aviation noise disrupting sleep having particularly deleterious effects. The only questions remaining are, “When will the FAA accept the fact that aviation noise exposure is a major health problem for the American public? When will the FAA take steps to reduce aviation noise exposure to prevent unnecessary illness and death in those Americans unfortunate to live near airports and in overflight communities?”

## DISCLOSURES

The opinions expressed represent those of the author. This paper is based on a review of articles published in peer-reviewed journals and official FAA documents and webpages. No human or animal subjects were used. No external financial support was received. There are no conflicts to disclose. This manuscript is based on a presentation at the 183<sup>rd</sup> meeting of the Acoustical Society of America in Nashville, TN on December 8, 2022, paper 4aNS8.

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