# AIRCRAFT NOISE IS A PUBLIC HEALTH PROBLEM, NOT JUST AN ANNOYANCE: Testimony submitted to the Maryland General Assembly in support of HB1103 and SB658 March 8, 2022

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*"The overwhelming majority of noise effect researchers today accept that there is a causal relationship between environmental noise exposure and increased cardiovascular risk."* Mathias Basner, MD PhD MSc, Professor, University of Pennsylvania School of Medicine, Philadelphia PA [1]

Transportation noise is the second worst environmental stressor affecting human health, exceeded only by air pollution.[2] Transportation noise and air pollution are inextricably intertwined; transportation noise is the unwanted, harmful soundtrack to gaseous and particulate matter air pollution from engines.

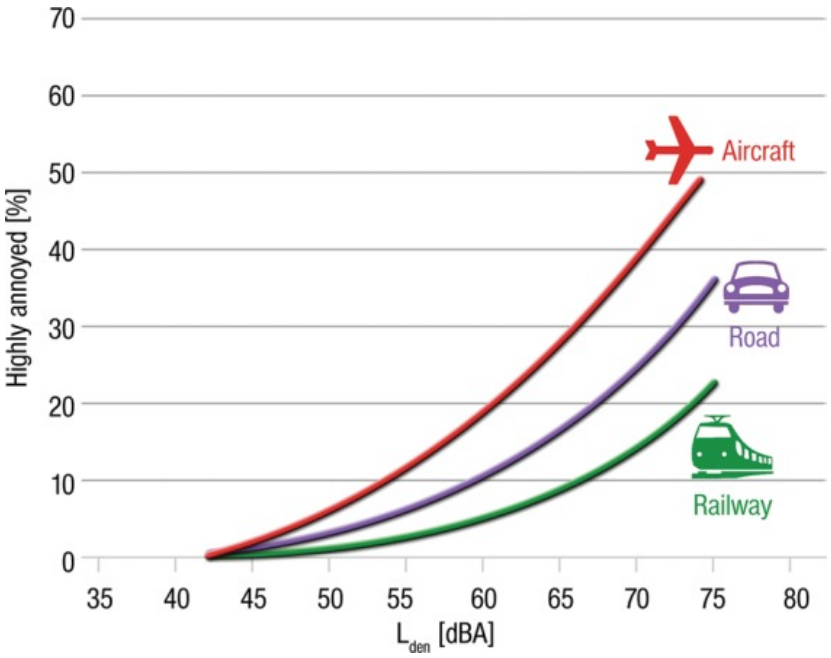


Figure 1. Transportation noise annoyance From Munzel et al.[2]

Transportation noise is a health problem for individuals and a public health problem for exposed populations. Much has been learned about these health effects from studies of how railway noise, road traffic noise, and aircraft noise affect humans. The adverse impacts

appear to be similar for all types of transportation noise, but aircraft noise is particularly annoying to humans. (See Figure 1) The effects of air pollution and noise pollution are additive, but the individual effects of each type of pollution can be teased out by sophisticated epidemiologic and statistical techniques.

Aircraft noise disrupts human activities, impairs learning, disturbs sleep, and causes increased cardiovascular disease and death among those exposed to it.[3,4] As reported in the media from multiple metropolitan areas across the country, the FAA's NextGen area navigation system, introduced to promote air traffic safety and efficiency, has exacerbated the problem of aircraft noise by concentrating flight paths over certain communities, including communities near BWI.[5] A few flights a day may not be a major problem, but 650+ flight operations a day at BWI, concentrated over specific communities, is. Many experts also question whether DNL (Day-Night Noise Level), which is the metric the FAA is using to determine harm from aircraft noise, is the appropriate measure for disruption of human activities and harm to public health. The scientific literature suggests that the total number of aircraft noise events above a certain threshold would be a better indicator.[6] Additionally, aircraft noise and transportation noise have disproportionate impacts on children, seniors, racial minorities, and the poor, although other groups living near some airports have also been greatly impacted.[7,8] A full discussion of these topics is beyond the scope of this testimony.

The non-auditory health impacts of noise have long been known,[9,10] but research done in the last several years has added to our understanding of the mechanisms by which noise, especially aircraft noise, causes adverse health effects. Noise isn't just unwanted sound; it has been redefined as unwanted and/or harmful sound.[11] Unwanted sound is annoying, and being annoyed has now been shown to be harmful to health.

Why does annoyance matter? For decades, the Federal Aviation Administration (FAA) has relied on the Schultz Curve[12,13] to document aircraft noise annoyance, but the recent FAA-funded Neighborhood Environmental Survey found that a much greater proportion of people

are highly annoyed by aircraft noise across all day-night noise levels (DNL) than was previously acknowledged.[14] Previous studies had found that only 12.5% of respondents were highly annoyed by aircraft noise, but the new study found that 42% of respondents were highly annoyed.

Annoyance isn't just a human emotion; being annoyed is stressful. In 2017, Tawakol et al. reported that stress causes vascular inflammation, which in turn is associated with cardiovascular disease and death.[15] Further work by Tawakol's group found that people exposed to aircraft noise had increased risk of heart attack and stroke regardless of other cardiac risk factors.[16]

Even before the precise mechanisms by which stress from aircraft noise caused cardiovascular disease were understood, causality had been established. The multiplicity of studies, in human and animal subjects, using a wide variety of techniques, meets the Bradford-Hill criteria for epidemiologic causality.[17] As Babisch wrote in 2014,[18]

*"**Environmental noise is a psycho-social stressor that affects subjective well-being and physical health.** [Emphasis added] Noise disturbs communication, concentration, relaxation and sleep. 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. Figure 1 [Figure 2 in this written testimony] shows an update of an earlier noise reactions scheme from 2002. 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.** [Emphasis added] This has to do with the slope of the exposure-response relationship and the empirical onset of the risk increase (intercept of the exposure response curve). Risk assessment and risk management relies on established exposure-response relationships."*

When Babisch wrote his paper almost a decade ago, the understanding of noise-induced cardiovascular disease was limited, as shown in his noise-effects reaction scheme. (see Figure 2)

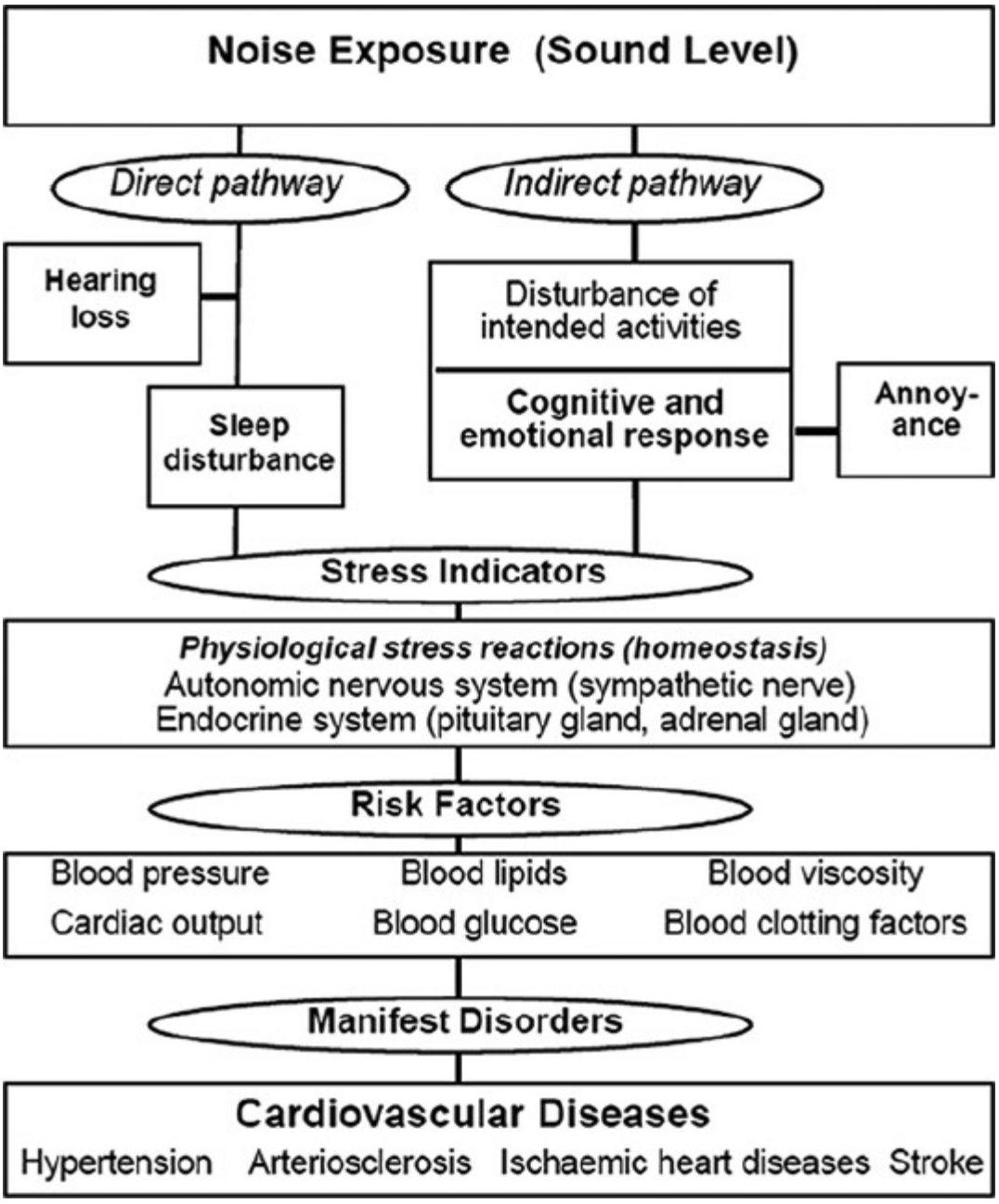


Figure 2. Noise effects reaction scheme. From Babisch[18]

Subsequent research[17, 19-29] has proven that aircraft noise causes cardiovascular disease, with the causal mechanisms now understood down to the hormonal, autonomic, cellular, subcellular, and molecular

levels. These effects and interrelationships are perhaps best illustrated in the Central Illustration (see Figure 3) from Munzel's 2018 article in the *Journal of the American College of Cardiology*.[19]

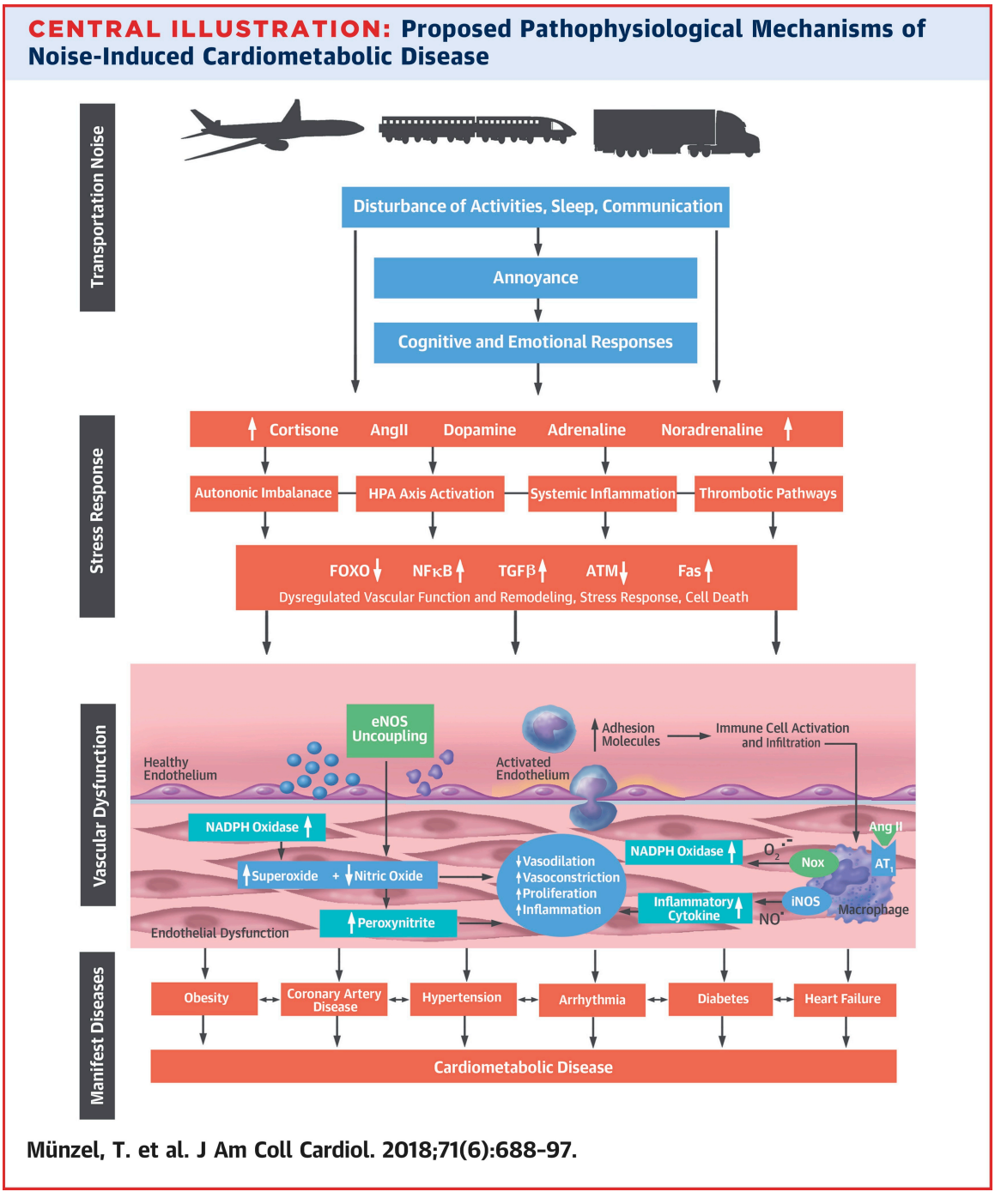


Figure 3. Proposed pathophysiological mechanisms of noise-induced cardiometabolic diseases. From Munzel T., et al.[19]

Generally, aircraft noise has direct involuntary physiological effects on stress hormones, heart rate, and blood pressure, and also causes sleep disturbance and interferes with activities and communication, causing annoyance, leading to an indirect stress response, causing vascular dysfunction. Both in turn cause cardiovascular disease and death. Multiple studies have confirmed these relationships.

Nighttime aircraft noise has more serious adverse cardiovascular health effects than daytime noise. This appears to be related to the evolutionary role of hearing as necessary for survival, with noise indicating danger and causing a physiologic stress response, and also to sleep deprivation. In fact, nighttime aircraft noise exposure has been shown to trigger heart attacks.[20] (See Figure 4)

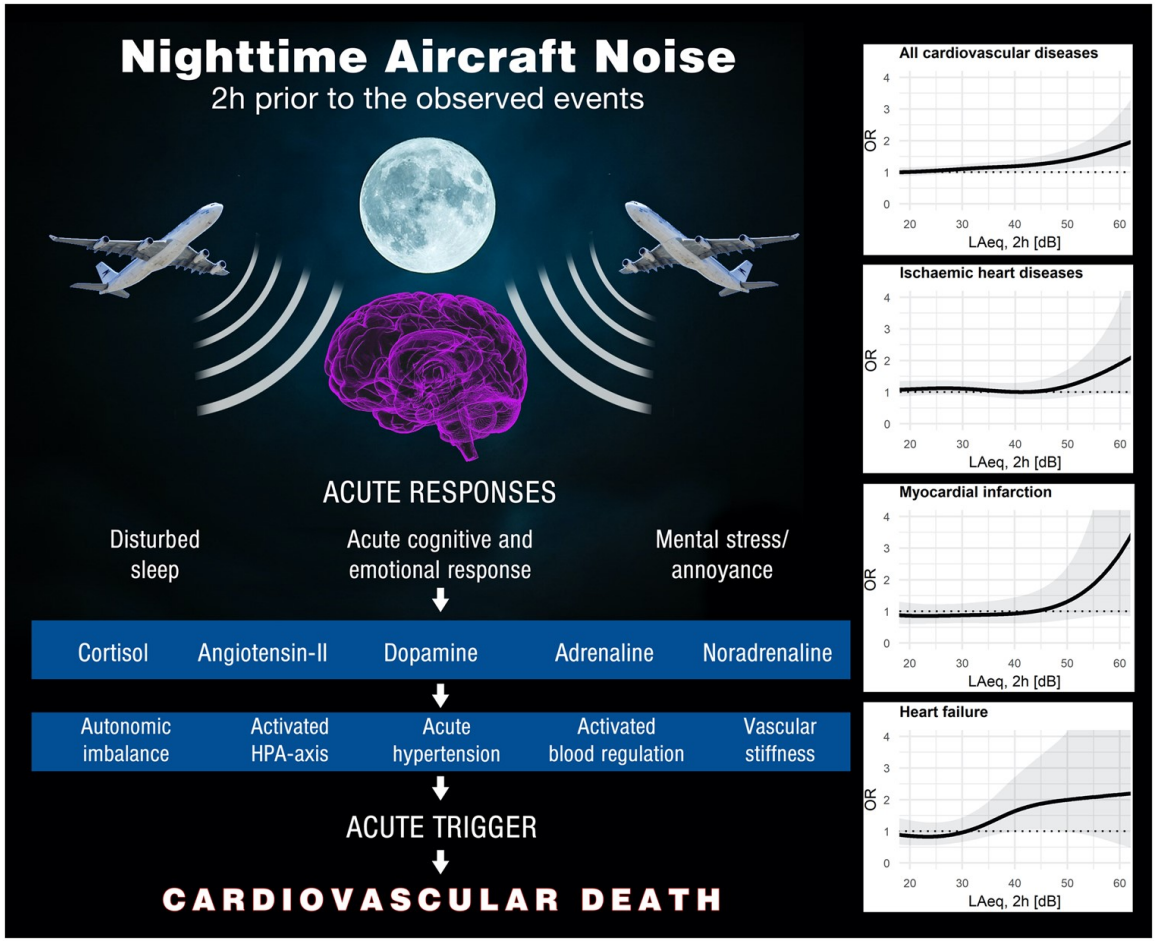


Figure 4. Nighttime aircraft noise causes heart attacks and death. From Munzel et al.[21]

Furthermore, research shows that humans do not habituate to aircraft noise, especially at night. In fact, there seems to be a priming effect, whereby prior noise exposure amplifies the negative effects of noise on the lining of blood vessels (endothelial function).[22,23]

There is more than enough science[17-29] to support immediate action to reduce aircraft noise, solely on the basis of its adverse health impacts on Americans living near airports and under aircraft flight paths. A recent "natural experiment"- a situation that allowed research to be done that could not otherwise be done due to economic or practical considerations- was the COVID-19 lockdown that reduced aircraft traffic and noise pollution from aircraft. A study published by the American Heart Association showed improvement in cardiovascular risk factors in populations exposed to aircraft noise when the noise decreased. [28.29]

The problem of aircraft noise is well recognized elsewhere in the world. For example, in 2018, the World Health Organization's (WHO) Environmental Noise Guidelines for the European Region[4] recommended much lower aircraft noise levels than those currently required by the FAA. Specifically, WHO recommended reducing average aircraft noise exposure below 45 decibels (dB) $L_{den}$ (average day-evening-night noise level) and nighttime aircraft noise exposure below 40 dB $L_{night}$ (average nighttime noise level). (see Appendix) Since the decibel scale is logarithmic, indicating mathematically that a 3 dB increase in sound pressure measurement denotes a doubling of sound energy, these are much lower sound energy levels than the 65 dBA standard used by the FAA.

Six general comments below anticipate testimony from representatives of the airline industry, airports, the FAA, and perhaps the aircraft and jet-engine manufacturing industries:

First, the Maryland General Assembly must be wary of statements that "more research is needed." This is a classic delay tactic. More research is always good, but no more research is needed to know that aircraft noise causes cardiovascular disease and increased mortality. The only research that needs to be done here and now is

to study the noise and air pollution from aircraft and airports in Maryland, especially Baltimore-Washington International Airport, and its effects on the health and welfare of people living in communities in Maryland. That is the task of the proposed Maryland Aviation Infrastructure Impacts Commission.

Second, research done in Europe does not need to be replicated by American researchers on American populations. Many of the articles cited in this testimony have appeared in American medical or scientific journals, and others have appeared in well-respected peer-reviewed European journals. The populations of Western Europe and those in the United States descended from European immigrants are genetically and physiologically similar. As far as is known, the enzymes and chemical reactions in human cells are the same the world over. The research not done in the United States has been done by reputable scientists at respected European universities and government agencies, using accepted research methodologies and standards. Assertions that research done in Europe must be replicated and validated in the U.S. are merely a delaying tactic that has no scientific merit.

Third, the Maryland General Assembly must learn from the "Tobacco Wars"[30], and must be aware of what might be called "Merchants of Doubt" tactics, based on the classic book by Oreskes and Conway.[31] These authors described how for decades the tobacco industry first denied that cigarette smoking caused lung cancer and then deliberately took steps to create doubt and sow confusion about whether this was true. Of course, there was no rational scientific doubt about a very strong causal relationship between smoking and lung cancer, but the delay allowed the tobacco industry to continue reaping billions of dollars of profits while millions of Americans died of smoking-related cancers and heart disease. Once one has seen the "denialists' playbook", it is easy to recognize the tactics: (1) deny that there is a problem, (2) express doubt about landmark scientific studies incontrovertibly documenting the problem, (3) fund research on alternate albeit unlikely possible causes of disease, (4) publicize that research, (5) insist that more research is needed, including replication of studies that do not need to be repeated, and finally, (6)

mount ad hominem attacks against reputable scientists. Since publication of *Merchants of Doubt*, similar strategies have come to light about lead in pipes, paint, and gasoline, asbestos, climate change, and even about COVID-19. In all cases, the result has been unnecessary, entirely preventable sickness, disability, and death for thousands to tens of thousands or even millions of Americans. Meanwhile, the costs of these public health disasters were transferred to and borne by the healthcare sector and American taxpayers.

Fourth, the FAA specifically may be among the purveyors of unnecessary doubt concerning the adverse health effects of aircraft noise and air pollution from aircraft. For example, regarding air pollution the FAA artificially limits study to a 5 mile radius around an airport, but prevailing wind patterns may extend the adverse health effects of particulate matter pollution beyond that radius.[32] Further examples of these denialist tactics include: (1) the continued use of the Schultz curve despite decades of criticism including from experts[13]; (2) the use of A-weighted decibels (dBA), used to measure the frequencies in human speech, to measure aircraft noise levels when aircraft noise is largely comprised of low frequencies better measured by C-weighting (dBC); (3) the use of DNL (day-night noise levels) measurements, which average noise levels over 24 hours, rather than counting the number and frequency of nighttime aircraft noise events[6]; and (4) wording in FAA publications and publications based on research funded by the FAA subtly raising unwarranted doubt.

One specific example of the FAA's *Merchants of Doubt* tactics is the paper by Peters et al.[33], funded by the FAA with FAA and Department of Transportation (DOT) employees among its authors. Some of the university-based authors were also funded by the FAA or DOT. Even the title of the paper- *Aviation noise and cardiovascular health in the United States: a review of the evidence and recommendations for research direction*- implies that only research done in the United States on Americans is valid. In this paper, published in 2018, there are mentions of more research being needed, of the fact that 10 of 11 studies reviewed were done in Europe, a confusing discussion of

noise metrics, statements such as "*existing research suggests that nighttime noise may disrupt sleep*" and "*these physiologic changes plausibly underlie the observed associations between chronic sleep disturbances and risk of cardiovascular disease"*. The conclusion states [with bolding added to highlight *Merchants of Doubt* language]:

*"As such, there is **an unmet need** and opportunity **to expand and strengthen the evidence base** regarding the potential health impacts of aviation noise. This evidence base would be useful in informing decision-making regarding aviation noise in the USA. With this need in mind, we call on the scientific community to leverage **emerging tools** to estimate **aviation and road traffic noise** to undertake a **broad research agenda** to **estimate** the potential adverse health effects of noise in the USA and more fully understand the causal mechanisms by which these **putative** effects occur as well as capturing the uncertainties in these impacts. The resulting evidence base will allow regulators and airport operators to ensure that continued aviation growth is accompanied by appropriate protections of the public health." [emphasis added]*

The *Merchants of Doubt* phrases raise or imply doubt when there can be no rational doubt about the voluminous scientific evidence about the adverse effects of aviation or aircraft noise on human health. There is no unmet need. The evidence base consists of thousands of articles in the peer-reviewed medical and scientific literature. There is no need for emerging tools. Aviation and road traffic noise are conflated when the role of aircraft noise can readily be separated from road traffic noise due to its intermittent nature associated with specific flight operations. There is no need for a broad research agenda. The adverse health effects of aircraft noise are not putative but real, and can be measured, not estimated. There are no uncertainties about any of this.

The Peters article was published in 2018, the same year that the WHO, based on its review of the same published peer-reviewed medical and scientific literature available to *anyone* with a computer and internet access, recommended reducing average aircraft noise exposure below 45 decibels (dB) $L_{den}$ (average day-evening-night

noise level) and nighttime aircraft noise exposure below 40 dB $L_{night}$ (average nighttime noise level). (See Appendix) What does the WHO know that the FAA can't seem to find, understand, or accept?

Fifth, another issue that must be raised is the question of "regulatory capture", defined as follows: "In economics and political science, the term **regulatory capture** is used to refer to a situation in which a regulated entity or industry exerts a strong influence over the government bodies or officials tasked with regulating that entity or industry. A government agency involved in a situation of regulatory capture may be referred to as a **captured agency**.[34] Specifically, has the FAA been "captured"? In light of the FAA's dismal regulatory failures in the Boeing 737MAX approvals[35]- as The New Yorker writer John Cassidy bluntly stated, *"Perhaps even more alarmingly, the report shows how the F.A.A., which once had a sterling reputation for independence and integrity, acted as a virtual agent for the company it was supposed to be overseeing."*[36]- and its utter failure for decades to deal effectively with the very real problems of aircraft noise and its health effects, one must question whether the FAA has been captured by the aircraft and jet engine manufacturers, the airlines, and the airport operators, making all decisions in their favor with almost complete disregard for the health and welfare of the public living near airports or below flight paths.

Sixth, anticipating objections that any attempt to restrict aircraft noise and air pollution will damage the economically important aviation sector, it is worth noting that aircraft noise and air pollution have become issues that are *negatively* affecting American competitiveness. Aircraft manufacturing is one of America's largest export industries, but as noise regulations are implemented internationally, American-made aircraft will not be purchased because they are too noisy and too polluting. Many American-made aircraft already run afoul of European noise regulations, and are subject to fines for exceeding operational noise limits. Incentivizing aircraft manufacturers, U.S.-based airlines, and airport operators to deal with noise pollution and air pollution would protect the health of Americans and help restore American manufacturing competitiveness.

The Maryland General Assembly must address three questions:

1. What are the adverse health effects of noise and air pollution from aircraft and airports on Marylanders?
2. What are the economic impacts, in terms of health care costs, worse educational performance, and lost productivity, from aircraft and airport noise and air pollution?
3. Since regulation of aircraft and airlines is within federal purview[37] ,what can the State of Maryland do to protect its citizens from noise pollution and air pollution from aircraft and airports?

## DISCLOSURE

Dr. Fink is an internist and medical management expert. He served on the Board of the American Tinnitus Association and is currently Board Chair of The Quiet Coalition, a program of Quiet Communities, Inc. Dr. Fink is an Expert Consultant to the World Health Organization on its Make Listening Safe program, and is a subject matter expert on noise and the public for the National Center for Environmental Health at the U.S. Centers for Disease Control and Prevention. He has presented papers on this subject at national and international scientific meetings and published articles about noise and health in peer-reviewed scientific journals. He has no financial interests in any relevant organization or company and no conflicts to disclose. A complete list of his publications is available from the author.

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## APPENDIX

The recommendations of the World Health Organization for aircraft noise[4] are copied here for reference.

"For average noise exposure, the GDG [Guidelines Development Group] strongly recommends reducing noise levels produced by aircraft below 45 dB $L_{den}$, as aircraft noise above this level is associated with adverse health effects. For night noise exposure, the

GDG strongly recommends reducing noise levels produced by aircraft during night time below 40 dB $L_{night}$, as aircraft noise above this level is associated with adverse effects on sleep. To reduce health effects, the GDG strongly recommends that policy-makers implement suitable measures to reduce noise exposure from aircraft in the population exposed to levels above the guideline values for average and night noise exposure. For specific interventions the GDG recommends implementing suitable changes in infrastructure. “