Air Traffic Noise & Human Health:

A Review of the Medical Literature

by Dr. M. Ivankovic[1]

INTRODUCTION

With increased urbanization and a continuously growing aviation industry, more and more research is being conducted on the effects of air traffic noise on human health in order to foster healthier cities in the future.

There is increasing evidence that air traffic has significant deleterious effects on human health. In the Greater Toronto Area hundreds of thousands of people, a large number of whom live many kilometers away from the Toronto Pearson International Airport, are exposed to regular daytime and nighttime noise levels well above 55dB[2]. According to the *World Health Organization (WHO)* and mounting medical evidence, this level of noise exposure has serious medical implications on the cardiovascular system, sleep and cognition.

What follows are highlights from the existing literature on the effects of aircraft noise and pollution.

THE DISTURBANCE FACTOR

Studies have found that significantly more people are annoyed by air traffic than road or rail traffic (*Munzel et al, 2014*).

PERCENTAGE OF PERSONS HIGHLY ANNOYED BY AIRCRAFT, ROAD AND TRAFFIC NOISES BASED ON SURVEYS ACROSS ELEVEN COUNTRIES.

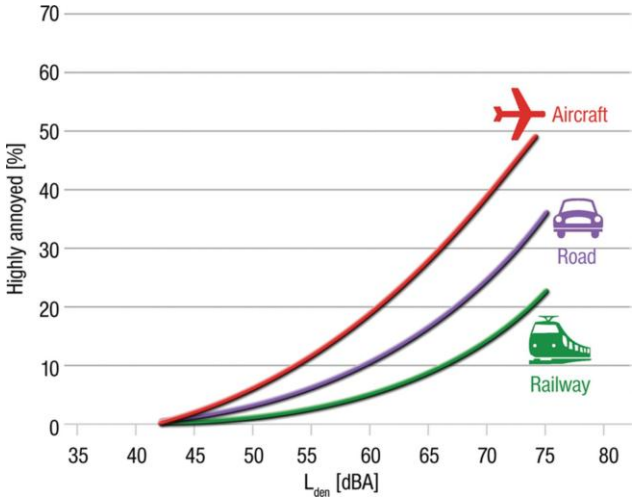

Figure obtained from Munzel at al., 2014

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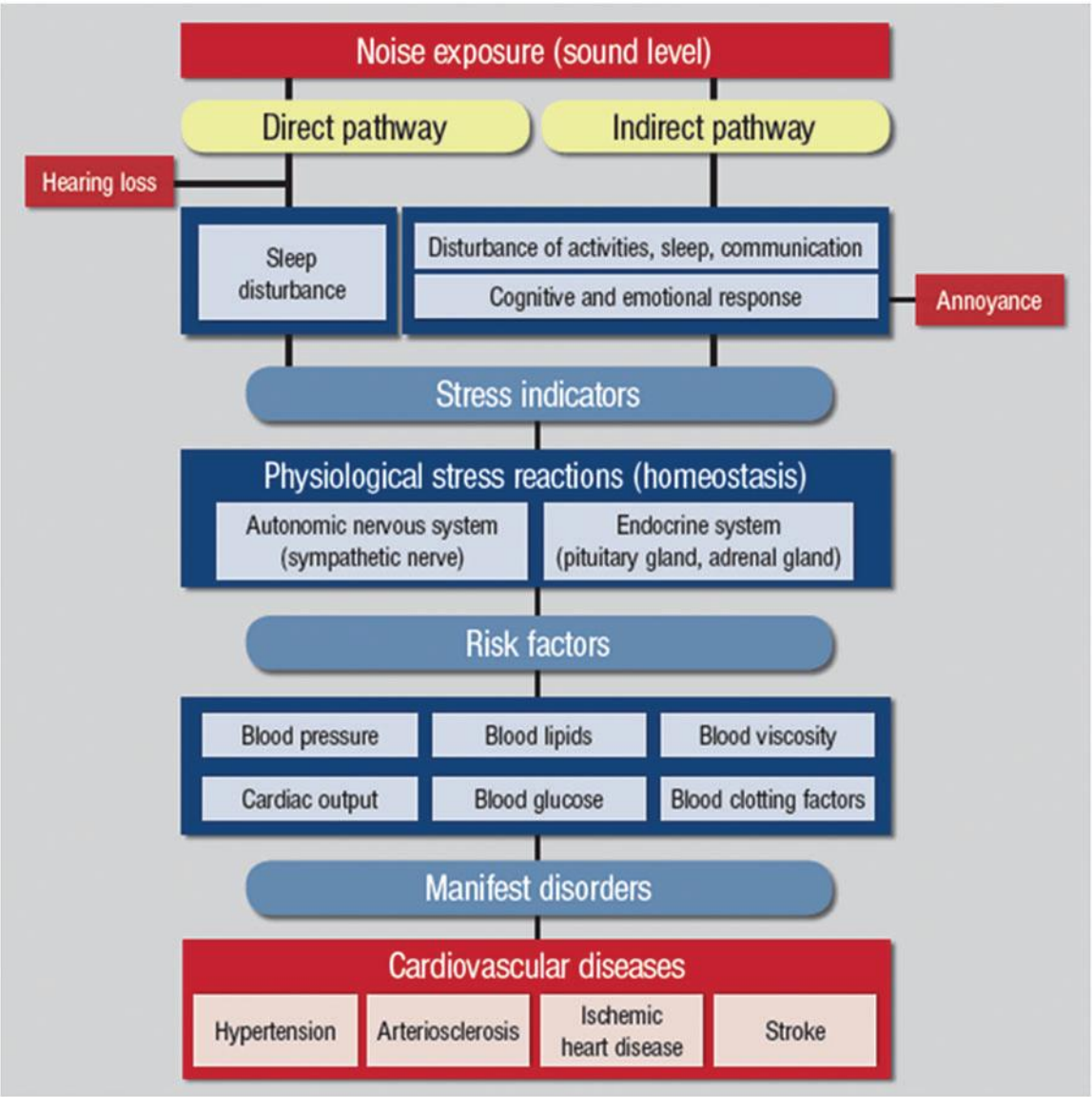
[2] *See Appendix 1, attached*



NOISE EFFECTS REACTION SCHEME

Obtained from Munzel et al. (2014).

CARDIOVASCULAR EFFECTS OF NOISE

Noise triggers the body to release stress hormones that increase blood pressure and heart rate. This can happen not only in a loud occupational environment but also in quiet settings when sleep or concentration is disturbed (Munzel et al. 2014). Chronic noise exposure triggers stress hormones that significantly impact many aspects of the body including blood pressure, blood lipids, blood glucose and clotting which leads to increased risk of heart disease and stroke (Munzel et al, 2014; Basner et al, 2014; Schmidt et al, 2013).

A study of residential communities around Heathrow airport found a significantly increased risk of heart disease and stroke in people that were exposed to regular aircraft noise (Hansell et al, 2013). Similarly, Swiss researchers found that aircraft noise was associated with increased mortality from heart attacks (Huss et al, 2010).

Studies have also found that people exposed to noise >60dB at home are a greater risk for type 2 diabetes (Dzhambov, 2014).

Effects of Noise on Sleep

Aircraft noise can cause sleep fragmentation increase the number of awakenings, reduce REM sleep, and increase heart rate and blood pressure (Hume et al, 2012).

Even ***while asleep*** the body reacts to environmental noise (Dang-Vu et al, 2010).

Nocturnal noise may be more hazardous to cardiovascular health as it interrupts the sustained decrease in sleeping blood pressure that is necessary for long-term heart health. Overall, long-term exposure to night noise increases risk of hypertension, stroke and heart attack (Munzel et al, 2014).

Acute and chronic sleep interruption and restriction are associated with inadequate insulin secretion by the body, reduced insulin sensitivity, changes in hormones controlling appetite, increased stress hormones and blood vessel function (Munzel et al, 2014).

An association has been found between daytime and nighttime noise exposure and blood pressure of children aged 9-10 years old (Van Kempen et al, 2006).

Circadian changes related to disrupted sleep may also adversely affect the immune system (Schmidt et al, 2013).

Particularly vulnerable groups include shift workers, pregnant women, the chronically ill and the elderly who already suffer from fragmented sleep (WHO, 2009).

In the World Health Organization's Night Noise Guidelines for Europe published in 2009, the WHO recommends *nocturnal* outside average target noise values of 40dB to avoid detrimental noise induced health effects (Fritschi et al. 2009). This would be equivalent to nighttime road traffic in a quiet residential neighbourhood.

The WHO guidelines summarized the relationship between outside night noise and health effects into four categories:

> **<30 dB** – Although individual sensitivities and circumstances differ, it appears that up to this level no substantial biological effects are observed.
>
> **30-40 dB** – A number of effects on sleep are observed from this range: Body movements, awakening, self-reported sleep disturbance, and arousals. The intensity of the effect depends on the nature of the source and the number of events. Vulnerable groups (e.g., children, the chronically ill and the elderly) are more susceptible. However, even in the worst cases the effects seem modest.
>
> **40-55 dB** – Adverse health effects are observed among the exposed population. Many people have to adapt their lives

TO COPE WITH THE NOISE AT NIGHT. VULNERABLE GROUPS ARE MORE SEVERELY AFFECTED.

>55 DB – THE SITUATION IS CONSIDERED INCREASINGLY DANGEROUS FOR PUBLIC HEALTH. ADVERSE HEALTH EFFECTS OCCUR FREQUENTLY, A SIZEABLE PROPORTION OF THE POPULATION IS HIGHLY ANNOYED AND SLEEP DISTURBED. *THERE IS EVIDENCE THAT THE RISK OF CARDIOVASCULAR DISEASE INCREASES.*

Aircraft noise exposure in the late evening in particular is associated with increased use of sleeping medication and sedatives (Franssen et al, 2004). Nighttime noise mitigation must include the first part of the night (late evening) to improve ability to fall asleep.

MENTAL HEALTH EFFECTS OF NOISE

Annoyance, which is one of the most common feelings induced by noise, disrupts ones' "peace of mind, the enjoyment of one's property, and the enjoyment of solitude" (Goines & Hagler, 2007, p. 287).

Noise annoyance is not only related to intensity but also to frequency i.e. an ambulance passing by several times a day may cause less annoyance than a jet flying overhead every minute. The level of background noise also influences annoyance so that an aircraft flying overhead during the night or during a Sunday picnic may be perceived as more annoying than it would otherwise during the daytime while driving in traffic.

Long-term noise exposure is associated with anxiety and depression and overall poorer psychological well-being (Lee et al, 2008). Exposure to aircraft noise is associated with an increased use of anti-anxiety medications (Floud et al, 2011). Noise may also contribute to anger, emotional instability, argumentativeness, sexual impotence and changes in mood (Goines & Hagler, 2007).

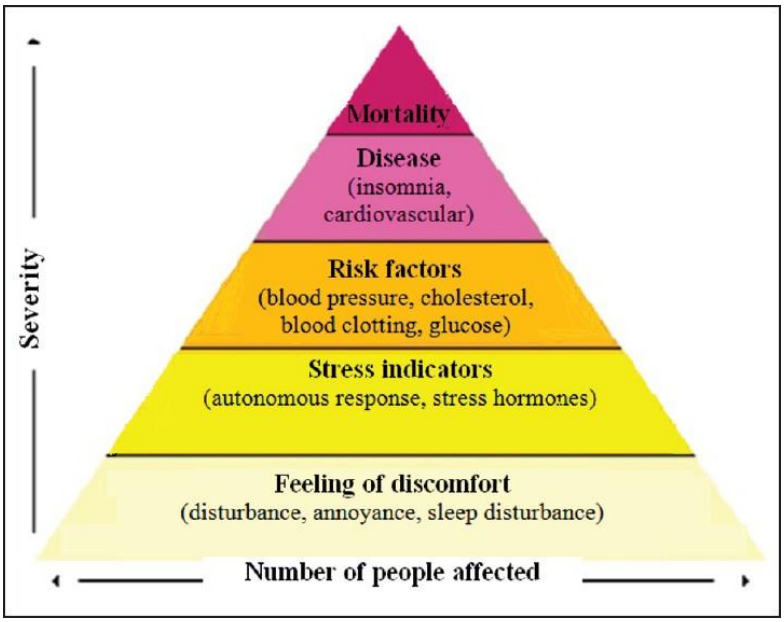
COGNITIVE IMPAIRMENT DUE TO NOISE

Children have been found to be the most vulnerable with respect to cognitive effects of noise (van Kamp & Davies, 2013). Many studies have shown environmental noise exposure negatively impacts children's learning and cognitive performance and that children with chronic aircraft noise exposure at school have worse reading ability, memory and performance on standardized tests (Basner et al, 2014).

AIR QUALITY

In addition to added research on cardiovascular, endocrine, immune and mental health, there is still much to be learned about the respiratory effects of air traffic. Air traffic has substantial impacts on air quality and ultrafine jet fuel particles are also suspected to be carcinogenic.

Noise is both an economic burden as well as a growing health concern. It contributes to cardiovascular disease which is the 2nd leading cause of death in Canada (Statistics Canada, 2011) and costs the economy more than $20.9 billion annually (Conference Board of Canada, 2010).



THE WORLD HEALTH ORGANIZATION PYRAMID OF HEALTH EFFECTS OF NOISE.
Figure obtained from Fritschi et al, 2011.

CONCLUSION

In summary, studies to date point to the contribution of noise to significant detrimental health effects and support the need for a greater recognition of the serious implications on health.

While more research is needed to fully elucidate the health burden of aircraft noise, as indicated in the World Health Organization's report on the Environmental Burden of Disease, "no exposure data and no scientific evidence does not mean no effect" (Fritschi et al, 2011).

In the meantime, the results of studies to date point to the need for stronger initiatives to reduce aircraft noise to reduce the burden of disease.

As air traffic continues to increase, it is imperative that public health advocates, policy makers and regulators prioritize noise prevention and mitigation to protect the health and quality of life of residential communities affected by air traffic.

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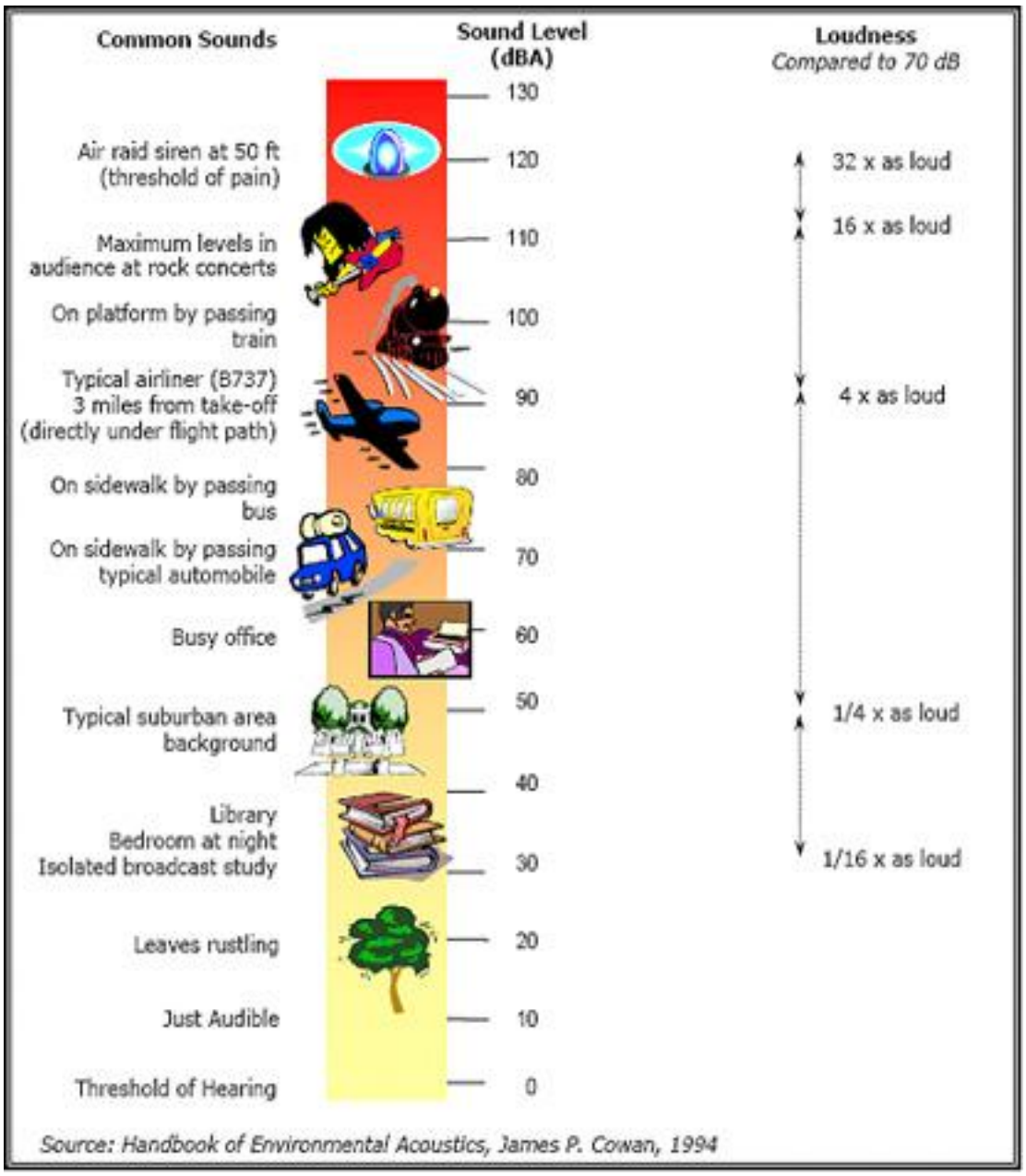
APPENDIX I

MEASURING NOISE LEVELS

The decibel (dB) scale is a logarithmic scale used to measure sound level. The threshold of hearing is assigned a sound level of 0dB. Painfully loud sounds occur at about 140dB. A non-exact rule of thumb is that every 10dB increase is perceived as double the noise therefore a 20dB increase would seem 4 times as loud and a 40dB increase would be perceived as 16 times as loud.



A lawnmower is typically 80-90dB and a normal conversation is 60dB. Prolonged exposure to sounds above 85dB causes permanent hearing damage. Even short exposure to sounds >100dB can cause hearing damage within minutes.

A Boeing 727 arriving 4km from the airport is approximately 85dB (*GTAA Noise Management Report, 2006*). A Boeing 737 climbing at 2800 feet is approximately 70dB (*NATS, 2015*). It is important to note that most airports typically do not report dB measurements for individual flights. Rather they may use alternate measurements such as Day-Night Average Sound Level (DNL). Many of these alternate measurements average noise over a 24hr period with nighttime flights weighted more to account for the lower background noise. Although flights may reach 90db, the reported DNL may be a much lower cumulative value as it includes the quiet periods in between flights, which may grossly misrepresent the noise impact.
